



ENVIRONMENTAL SERVICES

QUALITY ASSURANCE PROJECT PLAN

Town of Cicero
Brownfield Assessment Grant
'Petroleum and/or Hazardous Substances'
Cicero, Illinois 60804

Prepared for:

The Town of Cicero
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QUALITY ASSURANCE PROJECT PLAN APPROVAL SHEET

**U.S. EPA BROWNFIELDS ASSESSMENT GRANT-
'hazardous substance and/or petroleum'
The Town of Cicero, Illinois
AWARD DATE: June 2004**

On behalf of the Town of Cicero, this Quality Assurance Project Plan (QAPP) was prepared by K-Plus Environmental, LLC (K-Plus) for the Town of Cicero Brownfield Redevelopment Project. The QAPP was developed following the guidance presented in the United States Environmental Protection Agency (U.S. EPA) document QA/R-5 *Instructions on the Preparation of a Superfund Division Quality Assurance Project Plan*, dated June 2000.

Jon Peterson, U.S. EPA Project Manager

Jan Pels, U.S. EPA QA Reviewer

Craig Pesek, Town of Cicero Project Manager

Dan Caplice, K-Plus Project Manager

Scott Splittgerber, K-Plus QA Manager

Craig Chawla, STAT Analysis Corporation, Laboratory Project Manager

QUALITY ASSURANCE PROJECT PLAN DISTRIBUTION LIST

The following have received a copy of this Quality Assurance Project Plan:

Jan Pels, U.S. EPA QAPP Reviewer

Jon Peterson, U.S. EPA Project Manager

Craig Pesek, Town of Cicero Project Manager

Dan Caplice, K-Plus Project Manager

Scott Splittgerber, K-Plus QA Manager

Craig Chawla, STAT Analysis Corporation Laboratory Project Manager

ACRONYM LIST

ACM – Asbestos Containing Material
AHERA – Asbestos Hazard Emergency Response Act
ASTs – Aboveground Storage Tanks
ASTM – American Society for Testing and Materials
CONSULTANT COMPANY ACRONYM – ‘Consultant Company Name’
CFR – Code of Federal Regulations
CNS – Covenant Not to Sue
COC – Chain of Custody
DI – Deionized
DQOs – Data Quality Objectives
DRO – Diesel-Range Organic Compounds
GRO – Gasoline-Range Organic Compounds
HASP – Health and Safety Plan
HUD – U.S. Department of Housing and Urban Development
IEPA – Illinois Environmental Protection Agency
LCSs – Laboratory Control Samples
MDLs – Method Detection Limits
MS/MSD – Matrix Spike/Matrix Spike Duplicate
O&M – Operation and Maintenance
OSHA – Occupational Safety and Health Administration
PARCCS – Precision, Accuracy, Representativeness, Completeness, Comparability, and Sensitivity
PCBs – Polychlorinated Biphenyls
PE – Performance Evaluation
PID – Photoionization Detector
PPE – Personal Protective Equipment
QA – Quality Assurance
QAPP – Quality Assurance Project Plan
QA/QC – Quality Assurance/Quality Control

QC – Quality Control

QLs – Quantitation Limits

RPD – Relative Percent Difference

RSD – Relative Standard Deviation

SAP – Sampling and Analysis Plan

SOPs – Standard Operating Procedures

SVOCs – Semivolatile Organic Compounds

TPH – Total Petroleum Hydrocarbons

U.S. EPA – United States Environmental Protection Agency

USTs – Underground Storage Tanks

SRP – Illinois Voluntary Site Remediation Program

VOCs – Volatile Organic Compounds

1.0 PROJECT MANAGEMENT

The purpose of this document is to describe the personnel, procedures, and methods for ensuring the quality, accuracy, and precision of data associated with the Town of Cicero Brownfield Redevelopment Project. The Town of Cicero Brownfield Redevelopment Project received a \$350,000 U.S. Environmental Protection Agency (U.S. EPA) hazardous substance and/or petroleum grant. The purpose of this grant is to assess properties potentially impacted by hazardous substances and/or petroleum. Following the procedures outlined in this Quality Assurance Project Plan (QAPP) will ensure that the data collected meets the project objectives. This QAPP will be valid for up to five years, and it will be reviewed annually (from the date of approval) to insure that it is up to date. This annual review will be documented (letter format is ok) and sent to all recipients of the QAPP with any updated materials (current laboratory certificates, resumes for new key staff, etc.) to insert into the QAPP. If substantial changes are anticipated during the project period (new laboratories, additional analyses, new field methods, etc.), a call will be arranged with all parties that reviewed this QAPP to determine how to revise this document.

1.1 Project Organization and Responsibility

Figure 1 presents the organizational structure for the Town of Cicero Brownfield Redevelopment Project. All lines of communication, management activities, and technical direction within this project team will follow this organization arrangement. Any directions or communications from the U.S. EPA will be given to the Town of Cicero Brownfield Redevelopment Project Manager. The Town of Cicero Project Manager will subsequently communicate directions to K-Plus Environmental, LLC (K-Plus) project manager. The U.S. EPA project manager will be notified of all proposed changes in personnel.

Responsibilities of key project personnel are outlined below.

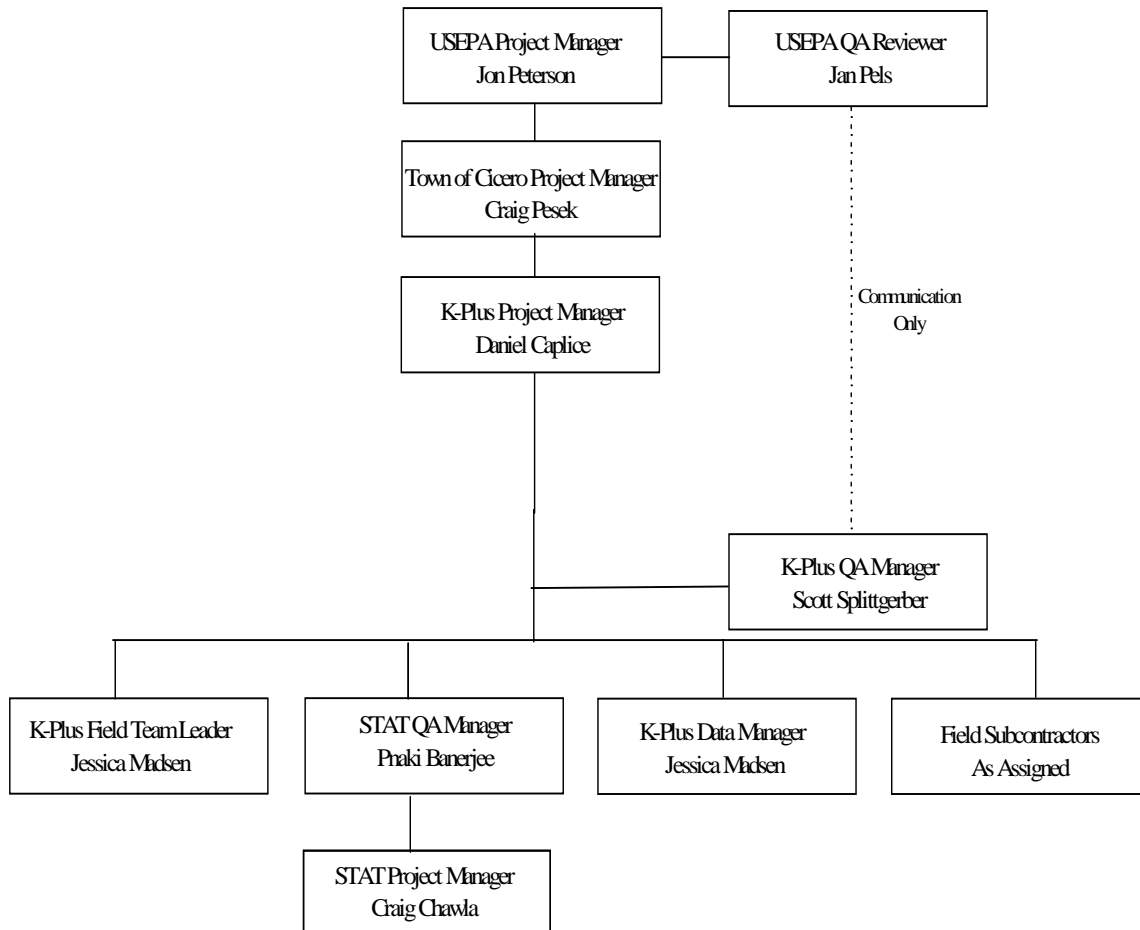
U.S. EPA Project Manager

1. Direct, review, and approve QAPP and Sampling and Analysis Plans (SAPs).
2. Provide technical consultation services to the Town of Cicero Project manager and K-Plus project manager.
3. Review progress reports detailing work accomplished.
4. Review all final reports.

U.S. EPA Quality Assurance Reviewer

1. Review and approve the QAPP.
2. Assist in review of the SAPs.

FIGURE 1
TOWN OF CICERO BROWNFIELD REDEVELOPMENT PROJECT
ORGANIZATIONAL CHART



Town of Cicero Project Manager

1. Direct project activities.
2. Prepare and submit progress reports detailing work accomplished, funds spent, and the project status.
3. Responsible for review of project deliverables, development of project planning, and the overview of project strategies.
4. Review site reports for consistency with objectives stated in work plans.
5. Provide final signature on all assessments.

K-Plus Project Manager

1. Responsible for planning, coordinating, monitoring, and evaluating of project field activities.
2. Before sampling, meet with the Town of Cicero project manager, quality assurance (QA) manager, and field staff to discuss and establish sampling purposes, sampling methodology, number of samples, size of samples, sample preservation methods, chain-of-custody (COC) requirements, analyses required, and which samples will be duplicated in the field.
3. Resolve technical problems.
4. Meet with team members to discuss and review analytical results prior to completion of reports.
5. Responsible for environmental reports and documents.

K-Plus Quality Assurance Manager

1. Oversee assessment activities to ensure that sampling methodology, sample preservation methods, and COC procedures are being followed.
2. Assist in any QA issues with field or laboratory questions, as needed.
3. Conducts Field Audits.
4. Maintain a record of samples submitted to the laboratory, the analyses being performed on each sample, the final analytical results, and data validation reports.
5. Prepares Data Assessment Report (DAR).
6. Annual review of QAPP.

K-Plus Data Manager

1. Maintain a record of all samples collected and the sample identification information on each sample.
2. Manage data acquired from field assessments and laboratory analyses.
3. Assemble data into computer format.

K-Plus Field Team Leader

1. Complete on-site Health and Safety Plan (HASP) for each property to be investigated.
2. Complete a SAP for each property to be investigated prior to any field activities.
3. Be responsible for oversight of field activities and ensure that procedures for the field activities related to the QAPP are executed and documented properly.
4. Submit data generated during field assessment to the data manager.
5. Procuring, coordinating and qualifying all subcontractors.

K-Plus Field Technical Staff

1. Before sampling, meet with K-Plus project manager to discuss and establish sampling purposes, sampling methodology, number of samples, size of samples, sample preservation methods, COC requirements, analyses required, and which samples will be duplicated in the field.
2. Be responsible for collection of equipment needed for property assessment work, which would include personal protective equipment (PPE), sampling equipment, sample containers and coolers, water-level meters, monitoring devices, and any other equipment deemed necessary.
3. Oversee drilling and soil boring work to ensure that proper procedures are followed during monitoring well installation and soil sample collection from borings.
4. Monitor hazardous conditions while conducting field operations.
5. Submit COC records and field paperwork to field team leader.

STAT Analytical Corporation Laboratory Project Manager

1. Responsible for samples submitted to STAT Analytical Corporation (STAT), including those released to a subcontracted laboratory.
2. Responsible for summarizing quality assurance/quality control (QA/QC) requirements for the project, including those samples analyzed by subcontracted laboratories.
3. Maintain laboratory schedule and ensure that technical requirements are understood by laboratory personnel.
4. Provide technical guidance to K-Plus project manager.
5. Ensure accuracy of the laboratory data.

STAT Analytical Corporation QA Manager

1. Responsible for evaluating adherence to policies and ensuring that systems are in place to provide QA/QC as defined in the QAPP.
2. Initiate and oversee audits of corrective action procedures.
3. Perform data reviews.
4. Maintain documentation of training.

Mr. Jon Peterson will serve as the U.S. EPA project manager. The U.S. EPA QAPP reviewer will be Ms. Jan Pels. Mr. Craig Pesek is the Town of Cicero Brownfield Redevelopment Project, project manager for this project.

Mr. Dan Caplice will serve as the K-Plus project manager. Mr. Scott Splittgerber will serve as the K-Plus QA manager. The K-Plus data manager and the K-Plus field team leader will be Ms. Jessica Madsen. The field technical staff includes Mr. Scott Splittgerber, Mr. Aaron Colin, and Ms. Jessica Madsen, although other supporting staff from K-Plus may be assigned on an as-needed basis. Resumes for proposed K-Plus personnel are included in Appendix A.

All K-Plus site personnel will be trained as mandated by the Occupational Safety and Health Administration (OSHA) Act regulations (29 Code of Federal Regulations [CFR] 1910.120). Additionally, all site personnel will be properly trained in the procedures for collecting, labeling, packaging, and shipping of liquid and solid environmental samples. Persons conducting asbestos surveys will be certified by the Illinois Department of Public Health (IDPH). The K-Plus project manager will maintain personnel training records. Field personnel will be trained to use all monitoring devices and other equipment used in the field.

The laboratory selected for the majority of the analytical work required for this project is STAT located in Chicago, Illinois. STAT laboratory has been certified under the State of Illinois Environmental Protection Agency (IEPA) National Environmental Laboratory Accreditation Program (NELAP), which is administered by the State of Illinois. STAT NELAP Certification number for their Chicago, IL laboratory is 001853. As an IEPA NELAP - certified laboratory, STAT has undergone performance evaluations administered by the State of Illinois for method accuracy and precision. These evaluations meet the standards required by U.S. EPA. Mr. Don Cortez is the STAT laboratory director. Mr. Craig Chawla will serve as the STAT project manager. He will be ultimately responsible for ensuring the quality of the laboratory data. The STAT QA Manager will be Dr. Pinaki Banerjee.

For analysis of asbestos containing materials (ACM), STAT Chicago, Illinois will do the analyses. They are National Voluntary Laboratory Accreditation Program (NVLAP) certified.

The drilling subcontractor has not yet been selected for this project. However, all on-site drilling personnel shall have completed the applicable OSHA training. Additionally, drilling personnel will be required to comply with all site safety regulations covered in the site-specific HASP, provided under separate cover to this QAPP.

A geophysical survey subcontractor has not yet been selected for this project. However, in the event a geophysical survey is required, K-Plus will select a subcontractor to complete the geophysical survey using Electromagnetic (EM) profiling and Ground Penetrating Radar (GPR). The EM profiling will make two measurements. One, a soil electrical conductivity which profiles the subsurface terrain and two, a metal sensitive response which will identify any buried metal objects. The GPR will be used to fine tune the EM survey where anomalies exist. The GPR can provide the depth and shape of subsurface objects as well as relative soil type. All on-site geophysical survey personnel shall comply with all site specific HASP requirements. K-Plus personnel will oversee and assist any geophysical survey conducted.

1.2 Facility History/Background Information

The Town of Cicero Brownfield Redevelopment Project Brownfield Assessment Grant is a communitywide project, meaning that specific sites have not been identified for Phase II Property Assessments. Therefore, once the Brownfield sites have been identified for Phase II work, property-specific information will be provided with the SAPs.

1.3 Project Description and Schedule

The Town of Cicero Brownfield Redevelopment Project's Brownfield Assessment Grants are communitywide grants. The Town of Cicero has a list of potential Brownfield sites to be evaluated consisting of hazardous substance and/or petroleum contamination, and will prioritize the sites based on access to the properties, potential environmental issues, and redevelopment potential. The sites with the highest priorities will have Phase I and Phase II ESAs conducted as described in the cooperative agreement to understand the extent of environmental problems on a property. Once the environmental assessments are completed, the Town of Cicero will pursue cleanup and redevelopment, which is not part of these grant projects.

The entire Town of Cicero is the targeted community. Nine potential sites that have been identified are primarily abandoned or marginally used industrial sites. As the project progresses, sites may be added or removed from the list being considered for environmental assessments. Once the Brownfield sites have been identified for Phase II work, property-specific information will be provided with the SAPs.

The Town of Cicero Brownfield Redevelopment Project has retained K-Plus as their consultant to perform Phase I and Phase II ESAs. The Phase I and Phase II ESAs are designed to provide Town of Cicero Brownfield Redevelopment Project and the U.S. EPA with data to facilitate potential redevelopment of each property investigated. These data will be used to determine whether there is a threat from potential contaminants, solutions for any remedial activities, and estimated costs for site redevelopment. The Phase I ESA is predominantly a fact-finding investigation. The Phase II ESAs may consist of one or more of the following tasks:

- Collection and analysis of soil samples
- Collection and analysis of sediment samples
- Collection and analysis of groundwater samples
- Collection and analysis of surface water samples
- Collection and analysis of ACM and LBP, potentially
- Installation of groundwater monitoring wells
- Aquifer testing and evaluation of aquifer characteristics
- Test pits or trenching
- Evaluation of geophysical survey results
- Evaluation of natural bio-attenuation processes
- Evaluation of active remedial technologies.

Details of the property-specific sampling activities will be addressed in the individual SAPs. The findings of each Phase II will be presented in a Phase II ESA report, which is discussed in later sections of this QAPP.

K-Plus, estimates that it will take approximately 3 to 7 months to perform a Phase II for each property. In general, it will take 1 to 2 weeks to prepare a SAP and HASP, 3 to 10 weeks to perform fieldwork including laboratory analyses, 4 weeks to gather any additional necessary data, and 4 to 6 weeks to prepare a Phase II report. The time is dependent on field conditions and laboratory data requirements. Once all of the assessments are complete, the Phase II ESA report will be prepared. Table 1 (located at the end of the QAPP) presents the estimated time frames for this project.

For the project schedule, please note that Phase I ESAs and Phase II ESAs may be conducted concurrently for different sites. The Phase I and Phase II work will not follow in succession. Based on an ongoing evaluation of Town of Cicero Brownfield Redevelopment Project's Brownfield program and the priorities established by the Town of Cicero Brownfield Redevelopment Task Force, additional properties may have Phase I ESAs started while Phase II activities have already begun on other properties.

An IEPA NELAP - certified laboratory will be used to ensure overall analytical quality. STAT will be the primary laboratory used for lab analyses. Copies of the STAT IEPA NELAP certificates are included in Appendix B.

1.4 Data Quality Objectives (DQOs)

DQOs are qualitative and quantitative statements that clearly state the objective of a proposed project, define the most appropriate type of data to collect, determine the appropriate conditions for data collection, and specify acceptable decision error limits that establish the quantity and quality of data needed for decision making. The DQOs are based on the use of the data that will be generated. Different data uses may require different quantities of data and levels of quality.

1.4.1 Analytical Quality Objectives

Analytical quality objectives are used to ensure that the analysis will accurately and adequately identify the contaminants of concern, and to ensure that the analysis selected will be able to achieve the quantitation limits less than or equal to the target cleanup levels.

1.4.1.1 Field Screening

Field-screening instruments provide a lower quality of analytical data compared to laboratory equipment in a controlled environment. However, field methods provide rapid “real-time” results for field personnel in order to help guide field decision-making processes. These techniques are often used for health and safety monitoring, initial site characterization to locate areas for detailed assessment, and preliminary comparison of remedial objectives. This type of field-screening data can include measurements of pH, temperature, conductivity, turbidity, or similar monitoring data. Field measurements of pH, temperature, conductivity, and turbidity will be collected during groundwater and surface water sampling activities. During sampling and other property assessment activities, the breathing space of site personnel will be monitored for the presence of volatile organic compounds using a photo-ionization detector (PID). The PID will also be used to perform field screening of soil and sediment samples in order to assist in the selection of samples to be submitted for laboratory analysis. Generally, the soil interval with the highest PID readings at a boring or sampling location will be submitted to the laboratory. If no volatile organic compounds are detected by the PID, samples will be selected for laboratory analysis based on the following:

- Obvious discoloration, odor, or other visible signs of contamination.
- If no visible or odorous signs of contamination are evident, a sample from the zone directly above the water table will be submitted.
- A sample from a depth corresponding to the zone in the subsurface expected to contain the greatest concentration of contaminants will be submitted. This selection will be based on the type of release and the history of the area being investigated and will be determined by the K-Plus project manager.

1.4.1.2 35 Illinois Administrative Code (IAC) Part 742 – Tiered Approach to Corrective Action Objectives (TACO) Analyses

The Town of Cicero Brownfield Redevelopment Project may wish to obtain a Covenant Not to Sue (CNS) from the Illinois Governor's office once a Certificate of Completion has been issued by IEPA through 35 Illinois Administrative Code (IAC) Part 742 – Tiered Approach to Corrective Action Objectives (TACO). Therefore, all laboratory analyses will be conducted under 35 IAC Part 742 TACO DQO protocol.

STAT, an IEPA NELAP - certified laboratory, will be the primary laboratory for this project (Certificates located in Appendix B). As discussed in Section 1.1, a NELAP - certified laboratory is one that has undergone performance evaluations performed by an IEPA accredited authority, in this case the State of Illinois, for method accuracy and precision, and meets the requirements set forth by the U.S. EPA. All analyses e.g., volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), inorganic metals analyses, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenols [PCBs], hexavalent chromium, cyanide, mercury, pesticides, asbestos, lead based paint, metals by graphite furnace, percent moisture, herbicides, total organic content (TOC), and pH will be performed by STAT at their Chicago laboratory. Copies of the STAT - IEPA NELAP certificates are included in Appendix B. Table 2 summarizes the analyses performed by STAT.

1.4.2 Project Quality Objectives

The project quality objectives process is a series of planning steps designed to ensure that the type, quantity, and quality of environmental data used in decision making are appropriate for the intended application. There are five steps in the project quality objectives process that include problem statement, decision identification, decision inputs, assessment boundary, and the decision process. The details of these steps are provided in the following sections.

1.4.2.1 Problem Statement

The Town of Cicero Brownfield Redevelopment Project intends to use the U.S. EPA Brownfields Assessment Grant funds to investigate properties listed for redevelopment, and possibly several others as identified by members of the community. Based on the prioritization, the balance of the funds will be used to conduct Phase I and Phase II ESAs. The intention of the Phase Is will be to identify environmental conditions that may cause threats to re-development. The property-specific work plans will detail the proposed methods for identifying contaminants, assessing the hazards posed by these contaminants, and managing or remediating contaminants for property redevelopment.

Exposure assessments and proposed re-development use of each of the properties are discussed in the property-specific SAPs.

1.4.2.2 Decision Identification

Available information will be used to determine if the subject properties have been contaminated. To assess the feasibility of property redevelopment, the Town of Cicero Brownfield Redevelopment Project will ask the following questions:

- Do contaminant levels exceed applicable standards such as 35 IAC Part 742 TACO limits?
- Can the contaminants be managed by eliminating exposure pathways through engineering and institutional controls?
- Will the property require remediation prior to redevelopment?
- If remediation is too costly based on the expected land use, can the property be developed for another use?

1.4.2.3 Decision Inputs

Samples of soil, sediment, groundwater and/or surface water will be collected for analysis as described in the SAPs in order to assess the level of contamination. Samples will be collected to either assess the data gaps identified from work previously completed or assess Recognized Environmental Conditions (RECs) noted during the Phase Is. An REC is the presence or likely presence of any 'hazardous substance and/or petroleum's or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release of any 'hazardous substance and/or petroleum's or petroleum products into structures on the property or into the ground, groundwater, or surface water of the property or nearby properties. Such data gaps or environmental conditions may answer the following:

- What is the level of potential exposure to surface or subsurface soils at the property?
- What is the level of potential exposure to surface water and associated sediments at the property?
- What is the level of potential exposure to groundwater at the property?
- Have past uses of the property (or adjacent properties) impacted the soil, sediment, surface water, or groundwater?
- Did past 'hazardous substance and/or petroleum' handling or storage activities, if any, impact the property?
- If any former underground storage tanks (USTs) existed on the property, does contamination exist near the area of the identified tank?
- Have former aboveground storage tanks (ASTs) impacted the surrounding media at the property?
- Does fill material (such as slag) used at the property contain contaminants that may impact soil, sediment, surface water, or groundwater?
- Have uncontrolled dumping or landfilling activities occurred at the property, and if so, have they impacted the soil, sediment, surface water, or groundwater?

1.4.2.4 Assessment Boundary

A site map showing the assessment boundary will be provided in each SAP. Because target properties will be selected based on the results of Phase Is and the nature of environmental impacts will be property-specific, detailed information regarding the assessment boundaries cannot be determined currently. However, once the target properties are identified, information regarding the assessment boundaries will be included in the associated SAPs. The assessment boundary information in each SAP will include the property boundaries, potential exposure areas, and sample locations and depths. It should be noted that the assessment boundary will not necessarily be the property boundary.

The vertical assessment boundary will vary depending on the end use of the subject property. Under 35 IAC Part 742 TACO, vertical points of compliance differ for residential and commercial/industrial uses.

1.4.2.5 The Town of Cicero Brownfield Redevelopment Decision Process

IEPA - 35 IAC Part 742 TACO, generic numerical standards may be the applicable State standards for cleanup criteria. Soils and sediment will be compared to the applicable 35 IAC Part 742 TACO, Tier I Soil Remediation Objectives (SROs), soil land use standards presented in Table 3. The 35 IAC Part 742 TACO, Tier I SROs, soil standards for residential properties and commercial/industrial properties are presented in Table 3 (located at the end of the QAPP). Groundwater results will be compared with the 35 IAC Part 742 TACO, Tier I Groundwater Remediation Objectives (GROs), presented in Table 3. If sample results collected as part of the property assessment are all below the applicable 35 IAC Part 742 TACO remediation objectives (ROs), then the redevelopment project will proceed as planned.

If sample results exceed the applicable land-use specific 35 IAC Part 742 TACO ROs, the Town of Cicero Brownfield Redevelopment Project will consider the following options:

- If contaminant levels exceed the 35 IAC Part 742 TACO criteria, then Town of Cicero Brownfield Redevelopment Project may opt to resample the specific locations associated with elevated contaminant levels. If any of the resample results confirm the original data, Town of Cicero Brownfield Redevelopment Project will consider the second option listed below. If all the resample results are below the 35 IAC Part 742 TACO limits, no further remedial action will be pursued at the property.
- If soil or groundwater contaminant levels exceeding 35 IAC Part 742 TACO standards are associated only with a specific exposure pathway, Town of Cicero Brownfield Redevelopment Project may then conduct a property-specific risk assessment and pursue an exclusion of exposure pathways through the use of engineering and institutional controls. These controls may be implemented

- through an Operation and Maintenance (O&M) Agreement with 35 IAC Part 742 TACO.
- If an exposure pathway cannot be eliminated through engineering or institutional controls, then Town of Cicero Brownfield Redevelopment Project may develop a Remedial Action Plan to meet the needs of the proposed future use of the property.

1.5 Quality Assurance Objectives for Measurement

The overall QA objective for each project is to develop and implement procedures for field sampling, COC, laboratory analysis, and reporting using 35 IAC Part 742 TACO protocol. Specific procedures for sampling, COC, laboratory instrument calibration, laboratory analysis, reporting of data, internal quality control, audits, preventative maintenance of field equipment, and corrective action are described in other sections of this QAPP.

Data quality objectives for measurements during this project will be addressed in terms of precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS). The numerical PARCCS parameters will be determined from the project DQOs to ensure that they are met. The DQOs and resulting PARCCS parameters will require that the sampling be performed using standard methods with properly operated and calibrated equipment, and conducted by trained personnel.

1.5.1 Precision

Precision is the degree of agreement among repeated measurements of the same parameter under the same or similar conditions. Precision is reported as either relative percent difference (RPD) or relative standard deviation (RSD), depending on the end use of the data.

1.5.1.1 Field Precision Objectives

Field precision will be assessed through the collection and analysis of field duplicate samples. RPDs will be calculated for the detected analytes from investigative and field duplicate samples. Water matrix samples can be readily duplicated due to their homogeneous nature; conversely, the duplication of soil or sediment samples is much more difficult due to their non-homogeneous nature. Due to this difficulty, RPDs of ± 35 percent and ± 50 percent for water and soil sample field duplicates, respectively, will be used as advisory limits for analytes detected in both investigative and field duplicate samples at concentrations greater than or equal to five times its quantitation limit. A summary of duplicate samples to be collected is presented in Table 4 (presented at the end of the QAPP), along with the other quality control samples. Per the 35 IAC Part 742 TACO, field duplicate samples must be provided for each matrix (soil, groundwater, etc.) sampled. The minimum number of field duplicate samples required for each round of

sampling is one for every 20 samples. If there are fewer than 20 samples per matrix, one field duplicate per matrix will be submitted.

Field sampling for asbestos containing materials (ACM) will follow Asbestos Hazard Emergency Response Act (AHERA) sampling protocols. Asbestos sampling procedures are documented in K-Plus' SOP for bulk asbestos sampling included in Appendix E of this QAPP.

1.5.1.2 Laboratory Precision Objectives

For STAT, precision of laboratory analyses will be based upon laboratory matrix spike/matrix spike duplicate (MS/MSD) analyses. Precision is reported as RPD or RSD, and the equation to be used to determine precision is presented in Section 4.3.1. MS/MSD analyses will be either at a rate of 1 per 20 samples received by the laboratory or in accordance with laboratory Standard Operating Procedures (SOPs). Table 3b lists the MSD and RPDs used by STAT.

For the Asbestos STAT, analyst and laboratory accuracy is assessed by re-analysis of known reference and proficiency test samples. Those samples containing any asbestos are subjected to a statistical analysis wherein the analyst and laboratory bias is assessed and the accuracy of the analysis is entered into control charts for the individual analyst and for the laboratory as a whole. A similar analysis is performed on the comparative data between visual estimates of asbestos content and point count determinations. STAT QA Manual 2008 is included in Appendix C of this QAPP.

1.5.2 Accuracy

Accuracy is the extent of agreement between an observed or measured value and the accepted reference, or true, value of the parameter being measured.

1.5.2.1 Field Accuracy Objectives

The objective for accuracy of the field sample collection procedures will be to ensure that samples are not affected by sources external to the sample, such as sample contamination by ambient conditions or inadequate equipment decontamination procedures. Sampling accuracy will be assessed by evaluating the results of equipment and trip blank samples for contamination.

A trip blank will consist of a laboratory-prepared sample of reagent-grade water. Trip blanks will accompany sample containers and be subjected to the same handling procedures as the field samples, but will not be opened and will be shipped back to the laboratory with the samples. Trip blanks are required only when VOCs will be analyzed. Trip blanks will be submitted at the rate of one trip blank per shipping container containing field samples for laboratory VOC analysis. The trip blank samples will provide a measure of potential cross contamination of samples by VOCs during shipment and handling.

Equipment blanks will be collected by pouring laboratory-prepared water or distilled water over or through the field sampling equipment and collecting the rinsate in the proper analytical containers. Equipment blanks must be submitted to the laboratory with investigative samples and analyzed for the same parameters as the investigative samples. The minimum required under the U.S. EPA is one per 20 field samples per matrix or, if less than 20 samples are collected, one equipment blank per day per sample matrix.

Trip and equipment blanks will be analyzed during assessment activities in order to assess potential problems as they occur.

1.5.2.2 Laboratory Accuracy Objectives

STAT laboratory accuracy will be assessed by determining percent recoveries from the analysis of laboratory control samples (LCSs) or standard reference materials (SRMs). The analyses of MS/MSD samples are also utilized to determine laboratory accuracy by determining percent recoveries from the analysis of MS/MSD samples. MS/MSD samples will be collected for organic and inorganic analyses at a minimum frequency of 1 per 20 or fewer samples. The equation used to determine accuracy for this project is presented in Section 4.3.2.3.

The accuracy of the organics analyses also will be monitored through analysis of surrogate compounds. Surrogate compounds are added to each sample, standard, blank, and QC sample prior to sample preparation and analysis. Surrogate compounds are not expected to be found occurring naturally in the samples, but behave analytically similar to the compounds of interest. Consequently, surrogate compound percent recoveries will provide information on the effect that the sample matrix exhibits on the accuracy of the analyses.

In addition, please see Section 5.0 of the STAT QA Manual, located in Appendix C of this QAPP, for the laboratory's QA objectives.

Specific details of asbestos STAT QA methodologies are included in their Quality Manual 2008 located in Appendix C of this QAPP.

1.5.3 Representativeness

Representativeness is a qualitative term that describes the extent to which a sampling design adequately reflects the environmental conditions of the site. It also reflects the ability of the sample team to collect samples and laboratory personnel to analyze those samples in such manners that the data generated accurately and precisely reflect the conditions at the site.

1.5.3.1 Measures to Ensure Representativeness of Field Data

Representativeness will be achieved by establishing the level of allowable uncertainty in the data and then statistically determining the number of samples needed to characterize the population through the DQO process. It will also be achieved by ensuring that sampling locations are properly selected. Representativeness is dependent upon the proper design of the sampling program and will be accomplished by ensuring that this QAPP, the property-specific SAPs, and standard procedures are followed. The QA goal will be to have all samples and measurements representative of the media sampled. Field testing for pH, temperature, and specific conductivity stabilization prior to groundwater sampling will ensure that representative samples are collected. Soil intervals will be homogenized for all analyses except VOCs to help ensure that representative soil samples are collected. Suspected ACM and lead based paint samples will be collected to ensure enough material is collected to accurately represent the bulk sample.

1.5.3.2 Measures to Ensure Representativeness of Laboratory Data

Representativeness of laboratory data cannot be quantified. However, adherence to the prescribed analytical methods and procedures, including holding times, blanks, and duplicates, will ensure that the laboratory data is representative.

1.5.4 Completeness

Completeness is defined as the measure of the quantity of valid data obtained from a measurement system compared to the quantity that was expected under normal conditions. While a completeness goal of 100 percent is desirable, an overall completeness goal of 90 percent may be realistically achieved under normal field sampling and laboratory analysis conditions.

1.5.4.1 Field Completeness Objectives

The field-sampling team will take measures to have data generated in the field be valid data. However, some samples may be lost or broken during handling and transit. Therefore, field completeness goals for this project will be to have 90 percent of all samples be valid data. The equation for calculating completeness is presented in Section 4.3.5.1.

1.5.4.2 Laboratory Completeness Objectives

Laboratory completeness will be a measure of the quantity of valid data measurements and analyses obtained from all the measurements and analyses completed for the project. The laboratory completeness goal is for 90 percent of the samples analyzed to be valid data. The procedure for determining laboratory data validity is provided in Section 4.2.2. The equation for calculating completeness is presented in Section 4.3.5.1.

1.5.5 Comparability

The confidence with which one data set can be compared to another is a measure of comparability. The ability to compare data sets is particularly critical when a set of data for a specific parameter is compared to historical data for determining trends.

1.5.5.1 Measures to Ensure Comparability of Field Data

Ensuring that this QAPP and the property-specific SAPs are adhered to and that all samples are properly handled and analyzed will satisfy the comparability of field data. Additionally, efforts will be made to have sampling completed in a consistent manner by the same sampling team.

1.5.5.2 Measures to Ensure Comparability of Laboratory Data

Analytical data are comparable when the data are collected and preserved in the same manner followed by analysis with the same standard method and reporting limits. Data comparability is limited to data from the same environmental media. Analytical method quality specifications have been established to help ensure that the data will produce comparable results. Table 3a summarizes the laboratory reporting limits.

1.5.6 Sensitivity

Sensitivity is the ability of a method or instrument to detect a parameter to be measured at a level of interest.

1.5.6.1 Measures to Ensure Field Sensitivity

The sensitivity of the field instruments selected to measure temperature, conductivity, turbidity, and the dissolved oxygen (DO) of groundwater for this project will be measured by analyzing calibration check solutions, where appropriate, that equate to the lower end of the expected concentration range. The sensitivity of the PID used to screen samples for organic vapors is relative to background readings in ambient air.

1.5.6.2 Measures to Ensure Laboratory Sensitivity

The sensitivity requirements for laboratory analyses are to be such to an extent as to meet IEPA standards for both soil and groundwater, IEPA ACM standard of **1%**, (**AHERA**) and the U.S Department of Housing and Urban Development (HUD) standard for lead-based paint of 0.5 percent by weight. If analytical methods are deemed to be insufficiently sensitive, alternative analytical methods may be utilized. Additionally, minimum laboratory detection limits which exceed 35 IAC Part 742 TACO standards will be evaluated in the following manner:

- Is the compound expected to be a chemical of concern, or, if the reporting limit exceeds 35 IAC Part 742 TACO groundwater standards, was the compound detected in the surrounding soils? If the compound is not an expected COC or

detected in the soils, then the compound will be considered non-detect. If the compound is considered a COC or was detected in the surrounding soils, the compound will be evaluated in a human health risk assessment using half the detection limit.

- If the reported detection limit exceeds 35 IAC Part 742 TACO groundwater standards, does the compound have an established Federal maximum contaminant level (MCL), and if so, does the reporting limit meet the MCL. If the reporting limit meets the MCL, the compound will be considered non-detect. If the reporting limit exceeds the MCL, the compound will be evaluated as part of a human health risk assessment using half the reported laboratory detection limit.

Table 3a presents the laboratory reporting limits.

1.6 Documentation and Records

Records generated during Phase II activities are a critical part of any property assessment. K-Plus will use select documents for recording information during project activities. Records to be used for project documentation include field forms, field books, laboratory data sheets, COC forms, and technical papers. The Town of Cicero Brownfield Redevelopment Project will retain the records generated during assessment activities for a minimum of 10 years following the completion of this project. At that time, the Town of Cicero Brownfield Redevelopment Project will be contacted prior to disposal of these records.

At a minimum, the draft and final Phase II Site Assessment report submittal packages will include the following:

- Text describing field-sampling methodologies, analytical results, conclusions, and recommendations.
- Figures showing property location, property boundaries, sampling locations, and summaries of impacted areas.
- Tables comparing all laboratory data to the applicable standards.
- Tables summarizing QA/QC analytical results.
- Complete laboratory data reports, including copies of all COC records.
- Copies of soil boring, groundwater, sediment, and surface water sampling logs.
- Other relevant material needed to support property redevelopment.
- Data Assessment Report that discusses and compares overall field duplicate precision data from multiple data sets collected for the project for each matrix, analytical parameter, and concentration level.

2.0 DATA GENERATION AND ACQUISITION

The purpose of the QAPP is to produce reliable data that will be generated throughout the assessment by:

- Ensuring the validity and integrity of the data;
- Ensuring and providing mechanisms for ongoing control of data quality;
- Evaluating data quality in terms of PARCCS; and
- Providing usable, quantitative data for analysis, interpretation, and decision making.

2.1 Sampling Process Design

Sample locations, analytical parameters, and frequency of sampling are discussed in the property-specific SAPs. Laboratory test parameters for the sampling program will include analysis for one or more of the following parameters:

- VOCs (Method 8260)
- SVOCs (Method 8270)
- PAHs (Method 8310 or 8270 SIM)
- Total metals (Methods 6010 or 6020), including mercury (Methods 7470 and 7471) and hexavalent chromium (Method 7196A)
- Pesticides (Method 8081)
- Herbicides (Method 8151)
- PCBs (Method 8082)
- Cyanide (Methods 9010C and 9012B)
- Lead-based paint (Method 6010 or 7420)
- Asbestos (Method EPA-600/M4-82-020)

The laboratory SOPs for these analytical parameters are presented in Appendix C.

Analytical parameters will be chosen based on representative contaminants most commonly associated with the former activities and/or identified areas (IAs) at each property.

Sampling will occur as a stepwise process. During initial sampling activities, it is expected that a variety of chemicals of concern will be analyzed. The initial results may indicate that only certain chemicals of concern are present. Therefore, later rounds of sampling will include only those specific compounds or class of compounds present in the initial sampling events.

QA/QC samples will be submitted in accordance with the QAPP protocols presented in the following sections. Requirements for QA/QC samples are presented in Table 4.

2.2 Analytical Methods Requirements

In order to preserve the integrity of samples both before and during analyses, specific analytical methods and requirements for those methods will be followed. Samples will be collected, prepared, and analyzed in accordance with the analytical methods outlined in STAT SOPs (Appendix C). STAT will coordinate all analytical services for this assessment. The specific analytical method and reporting limits for each parameter are presented in Table 3a. Preparatory methods for analytical parameters are discussed in the STAT laboratory SOPs included in Appendix C.

Proper sample containers, preservation, holding times, and volumes for each analytical parameter are outlined in Table 5 (presented at the end of the QAPP). STAT will provide all sample containers and preservatives for this project. Sample containers for groundwater VOC analysis will be pre-preserved with acid by the laboratory. Metals will be preserved in the field using pre-measured acid vials. In addition, sample containers for groundwater cyanide analysis will be pre-preserved with NaOH. Soil containers for VOCs will be pre-preserved with methanol (10mLs for 10g soil).

All sample containers supplied by STAT will be cleaned according to U.S. EPA standards. QC documentation will be supplied with the sample containers and preservatives in order to verify their purity. The containers and preservatives can be traced back to their certificate of analysis from their lot number. The QC documentation/certificate of analysis shall be maintained on file with STAT. Additionally, STAT shall provide the field team with trip blanks for VOC analysis and laboratory-grade de-ionized (DI) water for rinsing field equipment and instruments.

2.3 Sample Handling and Custody Requirements

Proper sample handling and custody procedures are crucial to ensuring the quality and validity of data obtained through field and laboratory analyses. For example, the admissibility of environmental data as evidence in a court of law is dependent on the custody of the data. Custody procedure will be used to document the authenticity of data collected during the Town of Cicero Brownfield Redevelopment Project Brownfield Assessment Project. The data requiring custody procedures include field samples and data files that can include field books, logs, and laboratory reports. An item is considered in custody if it is:

- In a person's possession;
- In view of the person after being in their possession;
- Sealed in a manner that it can not be tampered with after having been in physical possession; or
- In a secure area restricted to authorized personnel.

2.3.1 Sample Collection Documentation

Sample-handling procedures include field documentation, COC documentation, sample shipment, and laboratory sample tracking. Various aspects of sample handling and shipment, as well as the proposed sample identification system and documentation, are discussed in the following sections.

2.3.1.1 Field Books

Detailed records of the field activities will be maintained in field books dedicated to the Town of Cicero Brownfield Redevelopment Project Brownfield Assessment Project. Entries will be dated and signed by personnel recording the data. The entries will be made in ink. Each field book will have a unique numerical identifier permanently attached, and each page will be numbered, permitting indexing of key data. At a minimum, information recorded in the field books will include documentation of sample locations, sampling times, types of samples collected, weather conditions, and any other information pertinent to the assessment.

2.3.1.2 Field Identification System

Each sample collected during property assessments will be given a unique identification code. Each unique sample identification will consist of the following:

- *Project Identification Code.* A two-letter designation will be used to identify the property from which the sample was collected. Examples of this include the following:
 - SG – Smitty’s Gas Station
 - BF – Bulk facility
- *Sample Matrix Code.* Each sample will be further identified by a code corresponding to the sample matrix:
 - GW – groundwater sample
 - SW – surface water sample
 - SD – sediment sample
 - SS – surface soil sample
 - SB – subsurface soil sample
 - TB – trip blank sample
 - EB –equipment blank sample
 - FD – field duplicate sample.
- *Location Code.* Lastly, each sample will be identified by a location code and interval as follows (note that surface water, sediment, and surface soil samples will be numbered consecutively and not given an additional location identifier):

- MW-## - monitoring well location
 - GP-## - location of Geoprobe® or other direct-push boring
 - B-## - location of borings completed by methods other than direct-push.
- *Examples.*
- SG-GW-MW-01 = groundwater sample from Monitoring Well 1 Smitty's Gas Station property
 - SG-GW-MW-01-FD = duplicate groundwater from MW 1

Sample bottle labels appropriate for the size and type of containers shall be provided by STAT. The sample containers will be labeled at the time of sample collection but prior to being filled. Each label will indicate at a minimum:

- Sample identification
- Date/time of sample collection
- Sampler's initials
- Required analyses
- Type of preservative.

All labels will be completed in waterproof ink. An example of a sample label is included in Appendix D.

2.3.1.3 Field Sample Handling

The possession and handling of samples will be documented from the time of collection to delivery to the laboratory. K-Plus field personnel are responsible for ensuring that COC procedures are followed. Field personnel will maintain custody of all samples until they are relinquished to another custodian, the laboratory, or to the freight shipper.

All samples must be catalogued on a COC form using sample identification codes. A copy of the COC form is included in Appendix D. The date and time of collection will be recorded on the form, as well as the number of each type of sample, the method of preservation, and the type of analysis. The COC SOP is located in Appendix E.

2.3.1.4 Field Sample Packaging and Shipping

Samples will be packaged and transported in a manner that maintains the integrity of the sample and permits the analysis to be performed within the prescribed holding time. Prior to shipment, each sample container will be inspected for a label with the proper sample identification code.

Samples will be either couriered or shipped via overnight mail to STAT in Chicago, IL. The laboratory will be contacted in advance to expect shipment so that holding times of the samples will be conserved. The COC forms will be sealed in a plastic bag and transported inside the sample cooler. In addition, any shipping receipts will be incorporated into the COC documentation. Samples will be packed in the cooler using bubble-wrap packing materials and ice will be sealed in a Ziploc®-type bag. Any samples suspected of being highly contaminated will additionally be sealed in a Ziploc®-type bag. The cooler will be taped closed using custody seals provided by STAT to prevent tampering during transport. Upon relinquishing the sample cooler to STAT, K-Plus field personnel will sign custody of the samples over to the laboratory by signing and dating the bottom of the COC form. One copy of the COC documentation will be retained by the K-Plus data manager and a second copy will be retained by the laboratory. The integrity of the custody seals shall be noted by STAT on the COC form upon arrival. In addition, the shipping label will be included with the COC form retained by the K-Plus data manager.

2.3.1.5 Field Documentation

Field COC procedures will ensure the proper documentation of each sample from collection in the field to delivery at the laboratory. Custody of samples shall be maintained and documented at all times. The documentation for each sample will include the following information:

- COC form
- Sample label with sample identification code
- Shipping documents.

This documentation will allow for proper identification and verification of all samples upon arrival at STAT.

2.3.2 Laboratory Chain of Custody

STAT will perform laboratory custody procedures for sample receiving and log-in, sample storage, tracking during sample preparation and analysis, and storage of data in accordance with their SOPs. The STAT project manager will be responsible for ensuring that laboratory custody protocol is maintained. The laboratory's SOP for sample custody is presented in Section 7.0 of the Laboratory QA Manual (Appendix C).

2.3.3 Final Evidence Files Custody Procedure

K-Plus will be responsible for the custody of the evidence files and maintain and update the contents of the files during the project. The evidence files will include all records relevant to sampling and analysis activities such as boring logs, field books, photographs, subcontractor reports, laboratory data deliverables, COC forms, and data reviews. K-Plus will retain this file for a period of 10 years after completion of the assessment.

2.4 Quality Control Requirements

The quality control requirements ensure that the environmental data collected is of the highest standard feasible as appropriate for the intended application. Facets of the quality control requirements are provided in the following sections.

2.4.1 Field Quality Control Requirements

Where applicable, QC checks will be strictly followed during the assessment through the use of replicate measurements, equipment calibration checks, and data verification by K-Plus field personnel. Field-sampling precision and data quality will be evaluated through the use of sample duplicates, equipment blanks, and trip blanks. Sample duplicates provide precision information regarding homogeneity, handling, transportation, storage, and analysis. Equipment blanks will be used to ensure that proper decontamination procedures have been performed and that no cross contamination has occurred during sampling or transportation. Trip blanks will be used with VOCs only, to ensure that transportation of samples has not contaminated the samples. If there is any discrepancy in the sample data, the K-Plus project manager will be notified and, if deemed necessary, re-sampling of the questionable point scheduled. Requirements for field QA/QC samples are listed in Table 4. QA/QC sample quantities are also identified in the property-specific SAPs.

2.4.2 Laboratory QC Requirements

The laboratory QA manager will be responsible for ensuring that the laboratory's data precision and accuracy are maintained in accordance with specifications. Internal laboratory duplicates and calibration checks are performed on one of every 20 samples submitted for analysis. Other internal laboratory QA/QC is performed according to laboratory SOP. Soil and water samples that are submitted for laboratory MS/MSD or spike and duplicate analyses will have an additional set of samples collected from the sample locations. In the case of VOCs, double the amount will be collected. Typically laboratories require two to three sample containers for each sample location, therefore, four to six sample containers will be collected for laboratory MS/MSD analyses (i.e., six TerraCore® sample tubes will be collected). If soil VOCs are preserved in the field with methanol, additional sample volume is not required for the MS/MSD analyses. For water analyses of SVOCs, Pesticides/PCBs/Herbicides, 1 Liter bottles are recommended by the laboratory. The bottles are equipped with screw caps with Teflon liners. Water samples containing residual chlorine should be field treated to remove the chlorine prior to collection. Plastic containers or lids may not be used for the storage of samples due to the possibility of sample contamination from the phthalate esters and other hydrocarbons within the plastic.

2.5 Instrument Calibration and Frequency

The calibration procedures to be employed for both the field and laboratory instruments used during the Town of Cicero Brownfield Redevelopment Project Brownfield Assessment Project are referenced in this section. Measuring and test equipment used in the field and laboratory will be subjected to a formal calibration program. The program will require equipment of the proper type, range, accuracy, and precision to provide data compatible with the specified requirements and the desired results. Calibration of measuring and test equipment may be performed internally using in-house reference standards, or externally by agencies or manufacturers.

The responsibility for the calibration of laboratory equipment rests with STAT. K-Plus field personnel are responsible for the calibration of K-Plus field equipment and field equipment provided by subcontractors.

Documented and approved procedures will be used for calibrating measuring and testing equipment. Widely accepted procedures, such as those published by U.S. EPA and American Society for Testing and Materials (ASTM), or procedures provided by manufacturers in equipment manuals will be adopted.

Calibrated equipment will be uniquely identified by the manufacturer's serial number, a K-Plus equipment identification number, or by other means. This identification, along with a label indicating when the next calibration is due (only for equipment not requiring daily calibration), will be attached to the equipment. If this is not possible, records traceable to the equipment will be readily available for reference. It will be the responsibility of all equipment operators to check the calibration status from the due date labels or records prior to using the equipment.

Measuring and testing equipment will be calibrated at prescribed intervals and/or as part of operational use. Frequency will be based on the type of equipment, inherent stability, manufacturer's recommendations, values given in national standards, intended use, and experience. Equipment will be calibrated whenever possible using reference standards having known relationships to nationally recognized standards or accepted values of physical constants. If national standards do not exist, the basis for calibration will be documented.

Physical and chemical reference standards will be used only for calibration. Equipment that fails calibration or becomes inoperable during use will be removed from service, segregated to prevent inadvertent use, and tagged to indicate the fault. Such equipment will be recalibrated and repaired to the satisfaction of the laboratory personnel or K-Plus field personnel, as applicable. Equipment that cannot be repaired will be replaced.

Records will be prepared and maintained for each piece of calibrated measuring and test equipment to document that established calibration procedures have been followed.

Records for subcontractor field equipment and K-Plus equipment used only for this specific project will be kept in the project files. STAT will maintain laboratory calibration records.

2.5.1 Field Instrument Calibration

Instruments used to gather, generate, or measure field environmental data will be calibrated with sufficient frequency and in such manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. Field measurement instruments will include PID units used to detect VOC, pH meters, conductivity meters, and temperature probes. As applicable, field instruments will be calibrated daily prior to use. The calibration will be consistent with the standard procedure. The field calibration procedures are presented in the field SOPs located in Appendix E.

Calibration procedures will be documented in the field logbook and field sampling sheets. Documentation will include the following:

- Date and time of calibration
- Identity of the person performing the calibration
- Reference standard used, if applicable
- Reading taken and adjustments to attain proper reading
- Any corrective action.

Trained personnel will operate field measurement equipment in accordance with the appropriate standard procedures or manufacturer's specifications. K-Plus field technical staff members will examine field measurement equipment used during field sampling to verify that they are in operating condition. The K-Plus field team leader will periodically audit the calibration and field performance of the field equipment to ensure that the system of field calibration meets the manufacturer's specifications.

2.5.2 Laboratory Instrument Calibration

The proper calibration of laboratory equipment is a key element in the quality of the analysis done by the laboratory. Each type of instrumentation and each U.S. EPA-approved method have specific requirements for the calibration procedures, depending on the analytes of interest and the sample medium.

The calibration procedures and frequencies of the equipment used to perform the analyses will be in accordance with requirements established by the U.S. EPA. The laboratory QA manager will be responsible for ensuring that the laboratory instrumentation is maintained in accordance with specifications. Individual laboratory SOPs will be followed for corrective actions and preventative maintenance frequencies. Laboratory quality control, calibration procedures, and corrective action procedures are discussed in

Sections 5.0 and 11.0, 9.0, and 13.0, respectively, of the STAT QA Manual. Instrument preventative maintenance is discussed in Section 10. STAT's QA Manual is located in Appendix C.

2.6 Data Management

K-Plus field technical staff members will manage raw data during field activities. Data such as geologic profiles, pH readings, and pump test results will be recorded on the appropriate field forms (examples of which are located in Appendix D) or in field logbooks. The K-Plus data manager will periodically collect data gathered during assessment activities in order to maintain results. As appropriate, the K-Plus data manager will coordinate transfer of raw data to computer formats such as Microsoft® Excel or Microsoft® Access to better organize and track incoming data. This will enable the K-Plus data manager to identify any data gaps. Any flaws in field QA/QC will be brought to the attention of the K-Plus QA manager.

The STAT project manager will be responsible for laboratory data management. STAT procedures for data review and data reporting are discussed in Section 12.0 of STATs QA Manual, located in Appendix C. Analytical data reports generated by STAT will present all sample results, including all QA/QC samples. Soil results will be reported on a dry weight basis. All data, including QA/QC results, will become part of the project files and will be maintained by the K-Plus data manager. Upon report delivery, K-Plus personnel will analyze laboratory data in accordance with accepted statistical methodologies and will be supervised by the K-Plus data manager.

3.0 ASSESSMENT/OVERSIGHT

Performance and system audits will be completed to ensure that the field sampling activities and laboratory analyses are performed following the procedures established in this QAPP, including the attached SOPs, and the property-specific SAPs. The audits may be both internally and externally led, as further described below.

3.1 Technical Systems Audits

Generally, system audits are a qualitative measure of adherence to sampling QA measures overall, including sample collection handling, decontamination procedures, COC, and recording requirements in the field, as well as sample receiving, log-in, and instrument operating records in the laboratory.

3.1.1 Field Data

A K-Plus geologist will be present at the site during sampling activities. The geologist will provide the on-site supervision required during the project. The geologist will be in daily contact with the K-Plus field team leader, who will then review compliance with the project objectives and sampling protocol outlined in this QAPP. Any anticipated modifications to the sampling or measuring procedures will be reported to the Town of Cicero Project manager and U.S. EPA project manager. K-Plus field technical staff members will report modifications to the K-Plus project manager, and document the modification in the field logbook.

Sample data precision will be determined by the collection and subsequent analysis of sample duplicates, equipment blanks, and trip blanks to verify reproducibility.

3.1.2 Field Screening Instruments

K-Plus field technical staff members will audit and maintain the performance field-screening instruments. Instruments will be calibrated according to the standard procedures located in Appendix E, and regular preventative maintenance will be performed as described in Table 6 (located at the end of the QAPP).

3.1.3 Report Preparation

Prior to submittal to the Town of Cicero Brownfield Redevelopment Project and U.S. EPA, all reports will undergo a peer review conducted by a project team within K-Plus. All components of the report will be checked and initialed by a designated team member. Town of Cicero Brownfield Redevelopment Project will also review all reports prior to submittal to U.S. EPA.

3.1.4 Laboratory Data

Laboratory results will be reviewed for compliance against the DQO criteria for the level of reporting required.

3.2 Performance Evaluation Audits

Generally, performance audits are a quantitative measure of field sample collection and laboratory analyses quality.

3.2.1 Field Audits

The K-Plus QA manager will conduct audits of field activities. U.S. EPA may also conduct an independent field audit. At least one field audit will be completed near the beginning of the sample collection activities for each assessment. If a second phase of field activities is necessary and the second phase starts more than 6 months following the initial phase, then a second field audit will be completed. The field audit will include the following checklist:

Item	Description of Field Audit Activities	QA Manager Initials
1.	Review of field-sampling records	
2.	Review of field-measurement procedures	
3.	Examination of the application of sample identifications following the specified protocol	
4.	Review of field instrument calibration records and procedures	
5.	Recalibration of field instruments to verify calibration to the manufacturer's specifications	
6.	Review of the sample handling and packaging procedures	
7.	Review of COC procedures	

If deficiencies are observed during the audit, the deficiency shall be noted in writing and a follow-up audit may be completed if deemed necessary by the project QA manager. Corrective action procedures may need to be implemented due to the findings from the audit. Such actions will be documented in the field logbook.

3.2.2 Laboratory Audits

STAT will perform many, if not all, of the analytical services required during the assessments. As discussed in Section 1.4.1.2, STAT is a IEPA NELAP/NVLAP certified laboratory, and a copy of their IEPA NELAP-certificate is located in Appendix B. In addition, if any asbestos sampling is performed, analysis will be performed by STAT, a NVLAP-certified laboratory. A copy of their NVLAP certificate is also contained in Appendix B. As the primary contracted laboratory, STAT will be responsible for all analytical work for this project using SW-846 methods. The STAT QA manager will be responsible for ensuring that the laboratory data precision and accuracy are maintained in accordance with specifications and laboratory SOPs. As an IEPA NELAP -certified lab, STAT is routinely audited by the State of Illinois Accrediting Authority.

3.3 Reports to Management

For the duration of the project, monthly reports will be prepared by the K-Plus project manager and submitted to the Town of Cicero Project manager and U.S. EPA project manager. These reports will serve to inform the Town of Cicero Project manager and U.S. EPA of the project progress and any significant interim findings that have been identified. This will streamline the process of addressing issues as they arise and adjusting the program to better define the environmental concerns. At the completion of the assessment, draft and final project reports will be issued.

4.0 DATA VALIDATION/USABILITY

This section describes the QA activities that will be performed to ensure that the collected data are scientifically defensible, properly documented, and of known quality, and meet project objectives. All analytical data collected for the Town of Cicero Brownfield Redevelopment Project Brownfield Assessment Project will be validated.

The following three steps will be followed to ensure that project data quality needs are met.

1. **Data Verification** – Data verification is a process of evaluating the completeness, correctness, and contractual compliance of a data set against the method standard, SOP, or contract requirements. Data verification will be performed internally by the analytical group or laboratory generating the data. Additionally, data may be checked by an entity external to the analytical group or fixed laboratory. Data verification may result in accepted, qualified, or rejected data.
2. **Data Validation** – Data validation is an analyte- and sample-specific process that extends the qualification of data beyond method, procedural, or contractual compliance (i.e., data verification) to determine the analytical quality of specific data sets. Data validation criteria are based on the measurement performance criteria of the project QAPP. The group that generates the data will perform data validation. Data validation results are accepted, qualified, or rejected data.
3. **Data Usability Assessment** – Data usability assessment is the process of evaluating validated data to determine if the data can be used for purpose of the project (i.e., to answer the environmental questions or to make environmental decisions). Data usability will include the following sequence of evaluation:
 - First, individual data sets will be evaluated to identify the measurement performance/usability issues or problems affecting the ultimate achievement of project DQOs.
 - Second, an overall evaluation of all data generated for the project will be performed.
 - Finally, the project-specific measurement performance criteria and data validation criteria will be evaluated to determine if they were appropriate for meeting project DQOs.

In order to perform the data evaluation steps above, the reported data will be supported by complete data packages which include sample receipt and tracking information, COC records, tabulated data summary forms, and raw analytical data for all field samples, standards, QC checks and QC samples, and all other project-specific documents that are generated.

4.1 Instructions for Data Review, Validation, and Verification

Requirements

This section describes the process for documenting the degree to which the collected data meet the project objectives, individually and collectively. K-Plus will estimate the potential effect that each deviation from this QAPP may have on the usability of associated data items, its contribution to the quality of reduced and analyzed data, and its effects on the decision.

The following procedures will be implemented to verify and validate data collected during the project:

- *Sampling Design* – How closely a measurement represents the actual environment at a given time and location is a complex issue. Each sample will be checked for compliance with the specifications, including type and location. K-Plus will note deviations from the specifications, and discuss them with the U.S. EPA project manager.
- *Sample Collection Procedures* – Sample collection procedures identified in this QAPP will be followed. If field conditions require deviations, they will be discussed with the U.S. EPA project manager.
- *Sample Handling* – Deviations from the planned sample handling procedures will be noted on the COC forms and in the field logbooks. Data collection activities will indicate the events that occur during sample handling affecting the integrity of the samples.
 - K-Plus field technical staff members will evaluate the sample containers and the preservation methods used and ensure that they are appropriate to the nature of the sample and the type of data generated from the sample. Checks on the identity of the sample will be made to ensure that the sample continues to be representative of its native environment as it moves through the analytical process.
- *Analytical Procedures* – Each sample will be verified to ensure that the procedures used to generate the data were implemented as specified. Data

validation activities will be used to determine how seriously a sample deviated beyond the acceptance limit so that the potential effects of the deviation can be evaluated.

- *Quality Control* – QC checks that are to be performed during sample collection, handling, and analysis are specified in an earlier section of this QAPP. For each specified QC check, the procedures, acceptance criteria, and corrective action should be specified. During data validation, the corrective actions that were taken, which samples were affected, and the potential effect of the actions on the validity of the data will be documented.
- *Calibration* – Field and laboratory instrument calibrations will be documented to ensure that calibrations:
 - Were performed within an acceptance time prior to generation of measurement data;
 - Were performed in proper sequence;
 - Included the proper number of calibration points;
 - Were performed using a standard that bracketed the range of reported measurement results; and
 - Had acceptable linearity checks and other checks to ensure that the measurement system was stable when calibration was performed.

When calibration problems are identified, any data produced between the suspect calibration event and any subsequent recalibration will be flagged to alert data users.

- *Data Reduction and Processing* – Checks on data integrity will be performed to evaluate the accuracy of raw data and include the comparison of important events and duplicate rekeying of data to identify data entry errors. Section 12.0 of STAT's QA Manual (Appendix C) discusses their data reduction procedures.

4.2 Instructions for Validation and Verification Methods

This section describes the process that will be followed to verify and validate the project data.

4.2.1 Verification

Field data will be verified by the K-Plus QA manager by reviewing field documentation and chain-of-custody records. Data from direct-reading instruments used to measure conductivity, DO, and turbidity will be internally verified by reviewing calibration and operating records. The laboratory data will be verified in respect to the COC, units of measure, and citation of analytical methods. Data verification procedures followed by STAT are discussed in Section 12.4 and 12.5 of the QA Manual (Appendix C), and will include reviewing and documenting sample receipt, sample preparation, sample analysis (including internal QC checks), data reduction, and reporting. Any deviations from the acceptance criteria corrective actions taken, and data determined to be of limited usability (i.e., laboratory-qualified data) will be noted in the case narrative of the laboratory report. The QA manager will also verify the use of blanks and duplicates. All applicable reference and identification codes and numbers will be reviewed as part of the documentation.

4.2.2 Validation

Data validation will be conducted by K-Plus consistent with the procedure identified in Section 1.5 of this QAPP. The data verification/validation procedure will identify data as being acceptable, of limited usability qualified or estimated, or rejected. The conditions that result in data being qualified or estimated or rejected are identified in Section 1.5 of this QAPP. The results of the data verification/validation will be provided in data validation memoranda that are provided to K-Plus's Project Manager and are included in the Quality Assurance Management Reports. All sampling, handling, field analytical data, and fixed-laboratory data will be validated by entities external to the data generator. The validation procedure will specify the verification process of every quality control measure used in the field and laboratory. Data validation procedures followed by STAT are discussed in Section 12.4 of the QA Manual (Appendix C).

Each analytical report will be reviewed for compliance with the applicable method and for the quality of the data reported.

Data determined to be unusable may require that corrective action be taken. Potential types of corrective action may include re-sampling by the field team or reanalysis of the samples by the laboratory. The corrective actions taken are dependant upon the ability to mobilize the field team and whether the data are critical for the project DQOs to be achieved. Should K-Plus's QA Officer identify a situation requiring corrective action

during data verification/validation, K-Plus's Project Manager will be responsible for approving the implementation of the corrective action.

4.3 Instructions for Reconciliation with Data Quality Objectives

This section describes the scientific and statistical procedures/methods that will be used to determine whether data are of the right type, quality, and quantity to support environmental decision making for the project.

The Data Quality Assessment (DQA) process is described in *Guidance for the Data Quality Assessment Process: Practical Methods for Data Analysis*, EPA QA/G-9, July 1996. EPA QA/G-9 will be used to guide the data assessment on this project. The DQA process will consist of five steps:

1. Review DQOs and sampling design
2. Conduct preliminary data review
3. Select statistical test
4. Verify assumptions
5. Draw conclusions from the data.

While the formal DQA process presented in the guidance may not be followed in its entirety, a systematic assessment of the data quality will be performed. This process will include a preliminary data review. Data will be presented in tables and figures to identify the trends, relationships, and anomalies.

The overall usability of the data for the project will be assessed by evaluating the PARCCS of the data set to the measurement performance criteria in Section 1.5 of this QAPP using statistical quantities as applicable. The procedures and statistical formulas to be used for these evaluations are presented in the following sections.

4.3.1 Precision

In order to meet the needs of the project, data must meet the measurement performance criteria for precision. Project precision will be evaluated by assessing the RPD data from the field duplicate samples. Analytical precision will be evaluated by assessing the RPD data from either duplicate spiked sample analyses or duplicate sample analyses. The RPD between two measurements is calculated using the following simplified formula:

$$\text{RPD} = \frac{|R_1 - R_2|}{(R_1 + R_2)/2} \times 100$$

where: R_1 = value of first result
 R_2 = value of second result.

Overall precision for the sampling programs will be determined by calculating the mean RPD for all field duplicates in a given sampling program. This will provide an evaluation of the overall variability attributable to the sampling procedure, sample matrix, and laboratory procedures in each sampling program.

The overall precision requirement will be the same as the project precision. It should be noted that the RPD of two measurements can be very high when the data approach the quantitation limit of an analysis. The calculation of the mean RPD will include only the RPD values for field duplicate sample analyte data that are greater than or equal to five times the quantitation limit for an analysis.

Poor overall precision may be the result of one or more of the following:

- Field instrument variation
- Analytical measurement variation
- Poor sampling technique
- Sample transport problems
- Heterogeneous matrices.

In order to identify the cause of the imprecision, the field-sampling design rationale and sampling techniques should be evaluated by the reviewer, and both field and analytical duplicate/replicate sample results should be reviewed. If poor precision is indicated in both the field and analytical duplicates/replicates, then the laboratory may be the source of error. If poor precision is limited to the field duplicate/replicate results, then the

sampling technique, field instrument variation, sample transport, or heterogeneous sample matrices may be the source of error.

If the Data Validation Report indicates that analytical imprecision exists for a particular data set, then the impact of that imprecision on data usability must be discussed in the Data Assessment Report. It should be noted that the Data Validation Report is considered to be the QA/QC report supplied by the analytical laboratory, and the Data Assessment Report will be prepared by K-Plus and submitted as part of the Phase II document.

When project-required precision is not achieved and project data are not usable to adequately address environmental questions and to support project decision making, then the Data Assessment Report should address how this problem will be resolved and discuss the need for re-sampling.

4.3.2 Accuracy/Bias

In order to meet the needs of the data users, project data will follow the measurement performance criteria for accuracy/bias established in Section 1.5.2.

4.3.2.1 Sample Contamination

QC check samples data will be reviewed to evaluate the accuracy and potential bias of sample results. If field contamination exists, then the impact of field contamination on data usability will be discussed in the Data Assessment Report, and the K-Plus project manager and field team leader should be notified. Differentiate field sample collection and transport contamination from contamination introduced at the time of sample preparation and analysis. Note that sample contamination may result in either negative or positive bias. For example, improperly cleaned sample containers for metals analysis may result in the retention of metals on interior container walls. This would result in lower metals concentrations being reported than are actually present in the environmental sample, which is a negative bias. A positive bias would occur when sample container contamination results in an additive effect, meaning that reported analyte concentrations are higher than the true sample concentrations for that analyte.

4.3.2.2 Analytical Accuracy/Bias

The data from method/preparation blank samples, field blank samples, trip blank sample, surrogate spikes, MS/MSD samples, and LCSs will be used to determine accuracy and potential bias of the sample data. If the Data Validation Reports indicate that contamination and/or analytical inaccuracies/bias exist for a particular data set, then the impact of that contamination and/or analytical inaccuracies/bias on data usability will be discussed on the Data Assessment Report.

4.3.2.3 Overall Accuracy/Bias

The data from the method/preparation blank samples provide an indication of laboratory contamination that may result in bias of sample data. Sample data associated with method/preparation blank contamination will have been identified during the data verification/validation process. Sample data associated with method/preparation blank contamination are evaluated during data validation procedure to determine if analytes detected in the samples and the associated method/preparation blanks are “real” or are the result of laboratory contamination. The procedure for this evaluation involves comparing the concentration of the analyte in the sample to the concentration of the method/preparation blank taking into account adjustments for sample dilution and dry-weight reporting. In general, the sample data are qualified as not detected if the sample concentration is less than five times (ten times for common laboratory contaminants) the method/preparation blank concentration. Typically, the common quantitation limit for the affected analyte is elevated to the concentration detected in the sample.

The data from the field blanks and trip blanks provide an indication of field and transportation conditions that may result in bias of sample data. Sample data associated with contaminated field and trip blank samples have been identified during the data verification/validation process. The evaluation procedure and qualification of sample data associated with field blank and trip blank contamination is performed in the same manner as the evaluation procedure for method blank sample contamination, taking into account the difference in units for aqueous field blank samples collected during soil sampling programs.

Surrogate spike recoveries provide information regarding the accuracy/bias of the organic analyses on an individual sample bias. Surrogate compounds are not expected to be found in the samples and are added to every sample prior to sample preparation/purging. The percent recovery data provide an indication of the effect that the sample matrix may have on the preparation and analysis procedure. Sample data exhibiting matrix effects will have been identified during data verification/validation process.

Matrix spike sample data can provide information regarding the accuracy/bias of the analytical methods relative to the sample matrix. Matrix spike samples are field samples that have been fortified with target analytes prior to sample preparation and analysis. The percent recovery data provide an indication of the effect that the sample matrix may have on the preparation and analysis procedure. Sample data exhibiting matrix effects will have been identified during data verification/validation process.

Analytical accuracy/bias will be determined by evaluating the percent recovery data of LCSs. LCSs are artificial samples prepared in the laboratory using a blank matrix that is fortified with analytes from a standard reference material that is independent of the calibration standards. LCSs are prepared and analyzed in the same manner as the field

samples. The data from LCS analyses will provide an indication of the accuracy and bias of the analytical method for each target analyte.

Percent recovery is calculated using the following formula:

$$\%R = \frac{SSR - SR}{SA} \times 100$$

where: SSR = Spiked Sample Result
 SR = Sample Result or Background
 SA = Spike Added.

The percent recovery of LCSs is determined by dividing the measured value by the true value and multiplying by 100.

Overall accuracy/bias for the sampling events will be determined by calculating the percent accuracy measurements that meet the measurement performance criteria specified in Section 1.5.2 of this QAPP. Overall accuracy will be considered acceptable if the surrogate percent recoveries are met for at least 75 percent of the samples and the LCS percent recoveries are met for all samples and the MS/MSD percent recoveries are met for at least 75 percent of the samples.

The Data Assessment Report will discuss and compare overall contamination and accuracy/bias data from multiple data sets collected for the project for each matrix, analytical parameter, and concentration level. The Data Assessment Report will describe the limitations on the use of the project data if extensive contamination and/or inaccuracy/bias exists or when it is limited to a specific sampling or laboratory analytical group, data set, analytical parameter, or concentration level. The Data Assessment Report will identify qualitative and/or quantitative bias trends in multiple performance evaluation (PE) sample results for each matrix, analytical parameter, and concentration level. The impact of any qualitative and/or quantitative trends in bias on the sample data will be discussed. Any PE samples that have false positive and/or false negative results should be reported and the impact on data usability will be discussed in the Data Assessment Report.

When project-required accuracy/bias is not achieved and project data are not usable to adequately address environmental questions and to support project decision making, then the Data Assessment Report will address how this problem will be resolved and the potential need for re-sampling.

4.3.3 Sample Representativeness

In order to meet the needs of the data users, project data must meet the measurement performance criteria to sample representativeness specified in Section 1.5.3.

Representativeness of the samples will be assessed by reviewing the results of field audits and the data from field duplicate samples. If field duplicate precision checks indicate potential spatial variability, then this may trigger additional scoping meetings and subsequent re-sampling in order to collect data that are more representative of a non-homogeneous site. Overall sample representativeness will be determined by calculating the percent of field duplicate sample data that achieved the RPD criteria specified in Section 1.5.3 of this QAPP. Overall sample representativeness will be considered acceptable if the results of the field audits indicate that the approved sampling methods or alternate acceptable sampling methods were used to collect the samples, and the field duplicates RPD data are acceptable for at least 75 percent of the samples.

The Data Assessment Report will discuss and compare overall representativeness for each matrix, parameter, and concentration level. Data Assessment Reports will describe the limitations on the use of project data when overall non-representative sampling has occurred or when non-representative sampling is limited to a specific sampling group, data set, matrix, analytical parameter, or concentration level. If data are not usable to adequately address environmental questions and/or support project decision making, then the Data Assessment Report will address how this problem will be resolved and discuss potential need for re-sampling.

4.3.4 Sensitivity and Quantitation Limits

In order to meet the needs of the data user, project data must meet the measurement performance criteria for sensitivity as specified. Low point calibration standards should produce a signal at least ten times the background noise levels and should be part of a linear calibration curve. Document the procedures for calculating method detection limits (MDLs) and quantitation limits (QLs).

4.3.4.1 Overall Sensitivity and Quantitation Limits

The quantitation limits for the sample data will be reviewed to ensure that the sensitivity of the analyses was sufficient to achieve 35 IAC Part 742 TACO RO standards. The method/preparation blank sample data and LCSs percent recovery data will be reviewed to assess compliance with the measurement performance criteria specified in Section 1.5.6 of this QAPP.

Overall sensitivity will be assessed by comparing the sensitivity for each monitoring program to the detectability requirements for the analyses. Overall sensitivity will be

considered acceptable if quantitation limits for samples are less than the acceptable evaluation criteria (i.e., 35 IAC Part 742 TACO RO standards).

It should be noted that quantitation limits may be elevated as a result of high concentrations of target compounds, non-target compounds, and matrix interferences (collectively known as sample matrix effects). In these cases, the sensitivity of the analyses will be evaluated on an individual sample basis relative to the applicable evaluation criteria. The need to investigate the use of alternate analytical methods may be required if the sensitivity of the analytical methods identified in this QAPP cannot achieve the evaluation criteria because of sample matrix interference.

If Data Validation Reports indicate that sensitivity and/or QLs were not achieved, then the impact of that lack of sensitivity and/or higher QLs on data usability will be discussed in the Data Assessment Report.

The Data Assessment Report will discuss and compare overall sensitivity and QLs from multiple data sets collected for the project for each matrix, analytical parameter, and concentration level. The Data Assessment Report will describe the limitations on the use of the project data if project-required sensitivity and QLs were not achieved for all project data or when it is limited to a specific sampling or laboratory/analytical group, data set, matrix, analytical parameter, or concentration level.

When project-related QLs are not achieved and project data are not usable to adequately address environmental questions and to support project decision making, then the Data Assessment Report will address how this problem will be resolved and discuss the potential need for re-sampling. In this case, the Data Assessment Report will clearly differentiate between usable and unusable data for the users.

4.3.5 Completeness

In order to meet the needs of the data users, project data will follow the measurement performance criteria for data completeness outlined in Section 1.5.4.

4.3.5.1 Overall Completeness

Completeness will be assessed by comparing the number of valid (usable) sample results to the total possible number of results within a specific sample matrix and/or analysis. Percent completeness will be calculated using the following formula:

$$\% \text{ Completeness} = \frac{\text{Number of Valid (usable) measurements}}{\text{Number of Measurements Planned}} \times 100$$

Overall completeness will be assessed by calculating the mean percent completeness for the entire set of data obtained for each sampling program. The overall completeness for the Phase II will be calculated when all sampling and analysis is concluded. Overall completeness will be considered acceptable if at least 90 percent of the data are determined to be valid.

The Data Assessment Report will discuss and compare overall completeness of multiple data sets collected for the project for each matrix, analytical parameter, and concentration level. The Data Assessment Report will describe the limitation on the use of the project data if project-required completeness was not achieved for the overall project or when it is limited to a specific sampling or laboratory/analytical group, data set, analytical parameter, or concentration level.

When project-required completeness is not achieved and sufficient data are not available to adequately address environmental questions and support project decision making, then the Data Assessment Report will address how this problem will be resolved and discuss the potential need for additional re-sampling.

4.3.6 Comparability

In order to meet the needs of the data users, project data will follow the measurement performance criteria for comparability outlined in Section 1.5.5.

The comparability of data sets will be evaluated by reviewing the sampling and analysis methods used to generate the data for each data set. Project comparability will be determined to be acceptable if the sampling and analysis methods specified in this QAPP and any approved QAPP revisions or amendments are used for generating the soil, groundwater, sediment, and surface water data.

The Data Assessment Report will discuss and compare overall comparability between multiple data sets collected for the project for each matrix, analytical parameter, and concentration level. The Data Assessment Report will describe the limitation on the use of project data when project-required data comparability is not achieved for the overall project or when it is limited to a specific sampling or laboratory/analytical group, data set, matrix, analytical parameter, or concentration level.

For long-term monitoring projects, data comparability is extremely important. Project data will be compared to previously generated data to determine the possibility of false positives and/or false negatives. Variations detected in the data may reflect a changing environment or indicate sampling and/or analytical error. Comparability criteria will be established to evaluate these data sets in order to identify statistical outliers to trigger re-sampling as verified.

If it is determined that long-term monitoring data are not comparable, the Data Assessment Report will address whether the data indicate a changing environment or the anomalies are a result of sampling and/or analytical error. If data are not usable to adequately address environmental questions and/or support project decision making, then the Data Assessment Report will address how this problem will be resolved.

Overall comparability of data from split samples (samples that are collected at the same time from the same location and split equally between two parties using sample containers from the same source or vendor) will be evaluated by determining the RPD of detected analytes in both samples following data verification/validation. Analytes that are detected in only one of the two samples will be assessed by reviewing the data verification/validation reports for both data sets and determining the cause of the discrepancy. Overall comparability of split sample data will be considered acceptable if the RPD for detected analytes with concentrations greater than or equal to five times their respective quantitation limits does not exceed RPD acceptance criteria for field duplicate samples.

If screen/confirmatory comparability criteria are not met, then this will be documented in the Data Assessment Report and the effect on data usability will be discussed. If oversight split-sampling comparability criteria are not met, then this will be documented in the Data Assessment Report and the effect on data usability will be discussed. If data are not usable to adequately address environmental questions and/or support project decision making, then the Data Assessment Report will address how this problem will be resolved and discuss potential need for re-sampling.

Overall comparability of data from the groundwater monitoring program will be assessed by evaluating analyte concentrations over time. The data from monitoring events will be evaluated for trends, if necessary, using the Mann-Kendall test described in Section 4.3.4.1 of EPA QA/G-9. Suspected outliers will be assessed using the Extreme Value Test described in Section 4.4.3 of EPA QA/G-9. As the groundwater database becomes larger, it may be necessary to use different statistical methods to determine trends and outliers. Any changes to the statistical methods used for this project will be communicated to the U.S. EPA prior to initiating the change.

4.3.7 Data Limitations and Actions

Sources of sampling and analytical error will be identified and corrected as early as possible to the onset of sample collection activities. An ongoing data assessment process will be incorporated during the project, rather than just as a final step, to facilitate the early detection and correction of problems, ensuring that project quality objectives are met.

Data that do not meet the measurement performance criteria specified in this QAPP will be identified and the impact on the project quality objectives will be assessed and discussed within the Phase II. Specific actions for data that do not meet the measurement performance criteria depend on the use of the data and may require that additional samples are collected or the use of the data to be restricted.























5.0 REFERENCES

United States Environmental Protection Agency. 1993. *Data Quality Objectives Process for Superfund: Interim Final Guidance*. EPA 540-R-93-071, Office of Research and Development, Washington DC.

United States Environmental Protection Agency. 1994. *Guidance for Data Quality Assessments*. EPA QA/G-5, Office of Research and Development, Washington DC.

United States Environmental Protection Agency. 1996. *Guidance for the Data Quality Assessment Process: Practical Methods for Data Analysis*. EPA QA/G-9, Office of Research and Development, Washington DC.

TABLE 1
ESTIMATED PROJECT SCHEDULE

ID		Task Name	Duration	Start	Finish	Predecessors	31, '08							Sep 7, '08							Sep 14, '08		
							M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	
1		Property Profile Forms	30 days	Tue 9/9/08	Mon 10/20/08																		
2		ACERS Training	1 day	Tue 9/9/08	Tue 9/9/08																		
3		Prepare Eligibility Determinations	29 days	Tue 9/9/08	Fri 10/17/08																		
4		Submit Eligibility to USEPA	1 day	Mon 10/20/08	Mon 10/20/08	3																	
5		Phase I ESAs	60 days	Tue 9/9/08	Mon 12/1/08																		
6		gather historical research	30 days	Tue 9/9/08	Mon 10/20/08																		
7		site contact/interviews/questionnaire	5 days	Mon 10/20/08	Fri 10/24/08																		
8		site visit	5 days	Mon 10/27/08	Fri 10/31/08																		
9		report preparation	15 days	Mon 11/3/08	Fri 11/21/08	8																	
10		prepare Phase II scope of work	5 days	Mon 11/24/08	Fri 11/28/08	9																	
11		Property Profile Form Preparation	5 days	Mon 11/24/08	Fri 11/28/08	9																	
12		Property Profile Form Submittal	1 day	Mon 12/1/08	Mon 12/1/08	11																	
13		Revisit Eligibility - if changes notify USEPA	1 day	Mon 11/24/08	Mon 11/24/08	9																	
14		QAPP	114 days	Tue 9/9/08	Fri 2/13/09																		
15		pre-QAPP meeting	1 day	Tue 9/9/08	Tue 9/9/08																		
16		QAPP preparation	16 days	Tue 9/9/08	Tue 9/30/08																		
17		QAPP submittal	1 day	Mon 11/10/08	Mon 11/10/08	16																	
18		QAPP review	60 days	Tue 11/11/08	Mon 2/2/09	17																	
19		QAPP revision	7 days	Tue 2/3/09	Wed 2/11/09	18																	
20		QAPP re-submittal	1 day	Thu 2/12/09	Thu 2/12/09	19																	
21		QAPP approval	1 day	Fri 2/13/09	Fri 2/13/09	20																	
22		Phase II Subsurface Work	56 days	Mon 2/16/09	Mon 5/4/09																		
23		Finalize SOW	1 day	Mon 2/16/09	Mon 2/16/09	21																	
24		Field Work	10 days	Mon 2/16/09	Fri 2/27/09	21																	
25		Laboratory Analysis	20 days	Mon 3/2/09	Fri 3/27/09	24																	
26		Data Interpretation	6 days	Mon 3/30/09	Mon 4/6/09	25																	
27		Report Preparation	20 days	Tue 4/7/09	Mon 5/4/09	26																	
28		SRP Work	20 days	Tue 5/5/09	Mon 6/1/09	27																	
29		Identify SRP sites vs. nonSRP	5 days	Tue 5/5/09	Mon 5/11/09																		
30		Enroll SRP sites	5 days	Tue 5/5/09	Mon 5/11/09																		
31		Prepare SOW for follow-up investigation	5 days	Tue 5/5/09	Mon 5/11/09																		

Project: 17094 Schedule of Events
Date: Mon 11/10/08

Task



Rolled Up Task



Project Summary



Split



Rolled Up Split



External Milestone



Progress



Rolled Up Milestone



Deadline



Milestone



Rolled Up Progress












Summary




External Tasks




ID		Task Name	Duration	Start	Finish	Predecessors	31, '08						Sep 7, '08						Sep 14, '08			
							M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T
32		Field Work	10 days	Tue 5/5/09	Mon 5/18/09																	
33		Laboratory Analysis	20 days	Tue 5/5/09	Mon 6/1/09																	
34		Data Interpretation	5 days	Tue 5/5/09	Mon 5/11/09																	
35		Site Investigation Report	20 days	Tue 5/5/09	Mon 6/1/09																	
36		SIR Submittal	1 day	Tue 5/5/09	Tue 5/5/09																	
37		SIR Review by IEPA	60 days	Wed 4/15/09	Tue 7/7/09																	
38		Remedial Action Plan Preparation	30 days	Mon 3/16/09	Fri 4/24/09																	
39		RAP Review by IEPA	60 days	Wed 4/29/09	Tue 7/21/09																	
40		Draft NFR Letters from IEPA	23 days	Mon 8/31/09	Wed 9/30/09																	

Project: 17094 Schedule of Events
Date: Mon 11/10/08


Task




Rolled Up Task




Project Summary




Split




Rolled Up Split




External Milestone




Progress




Rolled Up Milestone




Deadline




Milestone



Rolled Up Progress



Summary



External Tasks




TABLE 2

LABORATORY ANALYSES

Table 2 - Laboratory Analyses by Laboratory	
Laboratory Name	Analyses to be performed/Method number/media, if other than soil and water
Lab Name 1 (STAT Analysis – Chicago, IL)	VOCs (8260), SVOCs (8270), Pesticides(8081)
	PCBs (8082), Herbicides (8151), PAH (8310)
	DRO, GRO, ERO (8015)
	TOC, pH
	Metals (6010), Mercury(7470/7471)
	Cyanide (9010), Hexavalent chromium (7196)
	Fine and Coarse Lead (soils)
Lab Name 2 (STAT Analysis – Chicago, IL)	Asbestos (bulk, soil)
	Paint chips (lead testing)
Lab Name 3 (STAT Analysis – Chicago, IL)	VOCs (air - TO-14)

TABLE 3A

**ANALYTICAL PARAMETERS, LABORATORY REPORTING LIMITS
AND 35 IAC PART 742 TACO SOIL AND WATER STANDARDS**

CAS No.	Analyte	Residential Route Specific Values for Soil		Construction Worker Route Specific Values for Soil		Soil Component of Groundwater Ingestion Exposure Route Values	
		Ingestion	Inhalation	Ingestion	Inhalation	Class I	Class II
67-64-1	Acetone	70,000	100,000	-----	100,000	25	25
71-43-2	Benzene	12	0.8	2,300	2.2	0.03	0.17
75-27-4	Bromodichloromethane	10	3,000	2,000	3,000	0.6	0.6
75-25-2	Bromoform	81	53	16,000	140	0.8	0.8
74-83-9	Bromomethane	110	10	1,000	3.9	0.2	1.2
78-93-3	2-Butanone						
75-15-0	Carbon disulfide	7,800	720	20,000	9.0	32	160
56-23-5	Carbon tetrachloride	5	0.3	410	0.90	0.07	0.33
108-90-7	Chlorobenzene	1,600	130	4,100	1.3	1	6.5
75-00-3	Chloroethane						
67-66-3	Chloroform	100	0.3	2,000	0.76	0.6	2.9
74-87-3	Chloromethane						
124-48-1	Dibromochloromethane	1,600	1,300	41,000	1,300	0.4	0.4
75-34-3	1,1-Dichloroethane	7,800	1,300	200,000	130	23	110
107-06-2	1,2-Dichloroethane	7	0.4	1,400	0.99	0.02	0.1
75-35-4	1,1-Dichloroethene	3,900	290	10,000	3.0	0.06	0.3
156-59-2	cis-1,2-Dichloroethene	780	1,200	20,000	1,200	0.4	1.1
156-60-5	trans-1,2-Dichloroethene	1,600	3,100	41,000	3,100	0.7	3.4
78-87-5	1,2-Dichloropropane	9	15	1,800	0.50	0.03	0.15
10061-01-5	cis-1,3-Dichloropropene	6	1.1	1,200	0.39	0.004	0.02
10061-02-6	trans-1,3-Dichloropropene	6	1.1	1,200	0.39	0.004	0.02
100-41-4	Ethylbenzene	7,800	400	20,000	58	13	19
591-78-6	2-Hexanone						
108-10-1	4-Methyl-2-pentanone						
75-09-2	Methylene chloride	85	13	12,000	34	0.02	0.2
1634-04-4	Methyl tert-butyl ether	780	8,800	2,000	140	0.32	0.32
100-42-5	Styrene	16,000	1,500	41,000	430	4	18
79-34-5	1,1,2,2-Tetrachloroethane						
127-18-4	Tetrachloroethene	12	11	2,400	28	0.06	0.3
108-88-3	Toluene	16,000	650	410,000	42	12	29
71-55-6	1,1,1-Trichloroethane	---	1,200	---	1,200	2	9.6
79-00-5	1,1,2-Trichloroethane	310	1,800	8,200	1,800	0.02	0.3
79-01-6	Trichloroethene	58	5	1,200	12	0.06	0.3
75-01-4	Vinyl chloride	0.46	0.28	170	1.1	0.01	0.07
1330-20-7	Xylenes, Total	16,000	320	41,000	5.6	150	150

All units are mg/Kg unless otherwise noted.

Based on 35 IAC Part 742, Appendix B Table A.

Bolded/Shaded values have detected results exceeding the lowest remediation objective.

Construction Worker Objectives from 35 IAC Part 742, Appendix B Table B.



CAS No.	Analyte	Residential Route Specific Values for Soil		Construction Worker Route Specific Values for Soil		Soil Component of Groundwater Ingestion Exposure Route Values	
		Ingestion	Inhalation	Ingestion	Inhalation	Class I	Class II
83-32-9	Acenaphthene	4,700	---	120,000	---	570	2,900
208-96-8	Acenaphthylene						
120-12-7	Anthracene	23,000	---	610,000	---	12,000	59,000
56-55-3	Benz(a)anthracene	0.9	---	170	---	2	8
50-32-8	Benzo(a)pyrene	0.09	---	17	---	8	82
205-99-2	Benzo(b)fluoranthene	0.9	---	170	---	5	25
191-24-2	Benzo(g,h,i)perylene						
207-08-9	Benzo(k)fluoranthene	9	---	1,700	---	49	250
218-01-9	Chrysene	88	---	17,000	---	160	800
53-70-3	Dibenz(a,h)anthracene	0.09	---	17	---	2	7.6
206-44-0	Fluoranthene	3,100	---	82,000	---	4,300	21,000
86-73-7	Fluorene	3,100	---	82,000	---	560	2,800
193-39-5	Indeno(1,2,3-cd)pyrene	0.9	---	170	---	14	69
91-20-3	Naphthalene	1,600	170	4,100	1.8	12	18
85-01-8	Phenanthrene						
129-00-0	Pyrene	2,300	---	61,000	---	4,200	21,000

All units are mg/Kg unless otherwise noted.

Based on 35 IAC Part 742, Appendix B Table A.

Bolded/Shaded values have detected results exceeding the lowest remediation objective.

Construction Worker Objectives from 35 IAC Part 742, Appendix B Table B.

CAS No.	Analyte	Residential Route Specific Values for Soil		Construction Worker Route Specific Values for Soil		Soil Component of Groundwater Ingestion Exposure Route Values	
		Ingestion	Inhalation	Ingestion	Inhalation	Class I	Class II
120-82-1	1,2,4-Trichlorobenzene	780	3,200	2,000	920	5	53
95-50-1	1,2-Dichlorobenzene	7,000	560	18,000	310	17	43
541-73-1	1,3-Dichlorobenzene						
106-46-7	1,4-Dichlorobenzene	---	11,000	---	340	2	11
108-60-1	2, 2'-oxybis(1-Chloropropane)						
95-95-4	2,4,5-Trichlorophenol	7,800	---	200,000	---	270	1,400
88-06-2	2,4,6-Trichlorophenol	58	200	11,000	540	0.2	0.77
120-83-2	2,4-Dichlorophenol	230	---	610	---	1	1
105-67-9	2,4-Dimethylphenol	1,600	---	41,000	---	9	9
51-28-5	2,4-Dinitrophenol	160	---	410	---	0.2	0.2
121-14-2	2,4-Dinitrotoluene	0.9	---	180	---	0.0008	0.0008
606-20-2	2,6-Dinitrotoluene	0.9	---	180	---	0.0007	0.0007
91-58-7	2-Chloronaphthalene						
95-57-8	2-Chlorophenol	390	53,000	10,000	53,000	4	4
91-57-6	2-Methylnaphthalene						
95-48-7	2-Methylphenol	3,900	---	100,000	---	15	15
88-74-4	2-Nitroaniline						
88-75-5	2-Nitrophenol						
91-94-1	3,3'-Dichlorobenzidine	1	---	280	---	0.007	0.033
99-09-2	3-Nitroaniline						
534-52-1	4,6-Dinitro-2-methylphenol						
101-55-3	4-Bromophenyl phenyl ether						
59-50-7	4-Chloro-3-methylphenol						
106-47-8	4-Chloroaniline	310	---	820	---	0.7	0.7
7005-72-3	4-Chlorophenyl phenyl ether						
106-44-5	4-Methylphenol						
100-01-6	4-Nitroaniline						
100-02-7	4-Nitrophenol						
62-53-3	Aniline						
92-87-5	Benzidine						
65-85-0	Benzoic acid	310,000	---	820,000	---	400	400
100-51-6	Benzyl alcohol						
111-91-1	Bis(2-chloroethoxy)methane						
111-44-4	Bis(2-chloroethyl)ether	0.6	0.2	75	0.66	0.0004	0.0004
117-81-7	Bis(2-ethylhexyl)phthalate	46	31,000	4,100	31,000	3,600	31,000
85-68-7	Butyl benzyl phthalate	16,000	930	410,000	930	930	930
86-74-8	Carbazole	32	---	6,200	---	0.6	2.8
84-74-2	Di-n-butyl phthalate	7,800	2,300	200,000	2,300	2,300	2,300
117-84-0	Di-n-octyl phthalate	1,600	10,000	4,100	10,000	10,000	10,000
132-64-9	Dibenzofuran						
84-66-2	Diethyl phthalate	63,000	2,000	1,000,000	2,000	470	470
131-11-3	Dimethyl phthalate						
118-74-1	Hexachlorobenzene	0.4	1	78	2.6	2	11
87-68-3	Hexachlorobutadiene						
77-47-4	Hexachlorocyclopentadiene	550	10	14,000	1.1	400	2,200
67-72-1	Hexachloroethane	78	---	2,000	---	0.5	2.6
78-59-1	Isophorone	15,600	4,600	410,000	4,600	8	8
62-75-9	N-Nitrosodimethylamine						
86-30-6	N-Nitrosodiphenylamine	130	---	25,000	---	1	5.6
98-95-3	Nitrobenzene	39	92	1,000	9.4	0.1	0.1
108-95-2	Phenol	23,000	---	61,000	---	100	100
110-86-1	Pyridine						
621-64-7	N-Nitrosodi-n-propylamine	0.09	---	18	---	0.00005	0.00005
87-86-5	Pentachlorophenol	3	---	520	---	0.03	0.14

All units are mg/Kg unless otherwise noted.

Based on 35 IAC Part 742, Appendix B Table A.

Bolded/Shaded values have detected results exceeding the lowest remediation objective.

Construction Worker Objectives from 35 IAC Part 742, Appendix B Table B.

CAS No.	Analyte	Residential Route Specific Values for Soil		Construction Worker Route Specific Values for Soil		Soil Component of Groundwater Ingestion Exposure Route Values	
		Ingestion	Inhalation	Ingestion	Inhalation	Class I	Class II
12674-11-2	Aroclor 1016	1	---	1	---	---	---
11104-28-2	Aroclor 1221	1	---	1	---	---	---
11141-16-5	Aroclor 1232	1	---	1	---	---	---
53469-21-9	Aroclor 1242	1	---	1	---	---	---
12672-29-6	Aroclor 1248	1	---	1	---	---	---
11097-69-1	Aroclor 1254	1	---	1	---	---	---
11096-82-5	Aroclor 1260	1	---	1	---	---	---

All units are mg/Kg unless otherwise noted.

Based on 35 IAC Part 742, Appendix B Table A.

Bolded/Shaded values have detected results exceeding the lowest remediation objective.

Construction Worker Objectives from 35 IAC Part 742, Appendix B Table B.

TACO Tier I Soil Remediation Objectives

CAS No.	Analyte	Residential Route Specific Values for Soil		Construction Worker Route Specific Values for Soil		Soil Component of Groundwater Ingestion Exposure Route Values	
		Ingestion	Inhalation	Ingestion	Inhalation	Class I	Class II
72-54-8	4,4'-DDD	3	---	520	---	16	80
72-55-9	4,4'-DDE	2	---	370	---	54	270
50-29-3	4,4'-DDT	2	---	100	2,100	32	160
309-00-2	Aldrin	0.04	3	6.1	9.3	0.5	2.5
319-84-6	alpha-BHC	0.1	0.8	20	2.1	0.0005	0.003
5103-71-9	alpha-Chlordane						
319-85-7	beta-BHC						
57-74-9	Chlordane	1.8	72	100	22	10	48
319-86-8	delta-BHC						
60-57-1	Dieldrin	0.04	1	7.8	3.1	0.004	0.02
959-98-8	Endosulfan I						
33213-65-9	Endosulfan II						
1031-07-8	Endosulfan sulfate						
72-20-8	Endrin	23	---	61	---	1	5
7421-93-4	Endrin aldehyde						
53494-70-5	Endrin ketone						
58-89-9	gamma-BHC	0.5	---	96	---	0.009	0.047
5566-34-7	gamma-Chlordane						
76-44-8	Heptachlor	0.1	0.1	28	16	23	110
1024-57-3	Heptachlor epoxide	0.07	5	2.7	13	0.7	3.3
72-43-5	Methoxychlor	390	---	1,000	---	160	780
8001-35-2	Toxaphene	0.6	89	110	240	31	150

All units are mg/Kg unless otherwise noted.

Based on 35 IAC Part 742, Appendix B Table A.

Bolded/Shaded values have detected results exceeding the lowest remediation objective.

Construction Worker Objectives from 35 IAC Part 742, Appendix B Table B.

CAS No.	Analyte	Residential Route Specific Values for Soil		Construction Worker Route Specific Values for Soil		Soil Component of Groundwater Ingestion Exposure Route Values	
		Ingestion	Inhalation	Ingestion	Inhalation	Class I	Class II
7429-90-5	Aluminum						
7440-36-0	Antimony	31	---	82	---		
7440-38-2	Arsenic	13.0/11.3	750	61	25,000		
7440-39-3	Barium	5,500	690,000	14,000	870,000		
7440-41-7	Beryllium	160	1,300	410	44,000		
7440-43-9	Cadmium	78	1,800	200	59,000		
7440-70-2	Calcium	---	---	---	---		
7440-47-3	Chromium	230	270	4,100	690		
7440-48-4	Cobalt	4,700	---	12,000	---		
7440-50-8	Copper	2,900	---	8,200	---		
57-12-5	Cyanide	1,600	---	4,100	---		
7439-89-6	Iron	---	---	---	---		
7439-92-1	Lead	400	---	700	---		
7439-95-4	Magnesium	325,000	---	730,000	---		
7439-96-5	Manganese	1,600	69,000	4,100	8,700		
7439-97-6	Mercury	23	10	61	0.1		
7440-02-0	Nickel	1,600	13,000	4,100	440,000		
7440-09-7	Potassium	---	---	---	---		
7782-49-2	Selenium	390	---	1,000	---		
7440-22-4	Silver	390	---	1,000	---		
7440-23-5	Sodium	---	---	---	---		
7440-28-0	Thallium	6.3	---	160	---		
7440-62-2	Vanadium	550	---	1,400	---		
7440-66-6	Zinc	23,000	---	61,000	---		

All units are mg/Kg unless otherwise noted.

Based on 35 IAC Part 742, Appendix B Table A.

Bolded/Shaded values have detected results exceeding the lowest remediation objective.

Construction Worker Objectives from 35 IAC Part 742, Appendix B Table B.



INORG Analyte	Residential Route Specific Values for Soil		pH Specific Soil Component of Groundwater Ingestion Route Values		
	Ingestion	Inhalation	Class I	Class II	
	pH Range 7.25 to 7.74				
Aluminum					
Antimony	31	---	5	20	
Arsenic	13.0/11.3	750	30	120	
Barium	5,500	690,000	1,800	1,800	
Beryllium	160	1,300	1,000	130,000	
Cadmium	78	1,800	59	590	
Calcium	---	---			
Chromium	230	270	32	No Data	
Cobalt	4,700	---	See TCLP/SPLP	See TCLP/SPLP	
Copper	2,900	---	330,000	330,000	
Cyanide	1,600	---	40	120	
Iron	---	---	See TCLP/SPLP	See TCLP/SPLP	
Lead	400	---	107	1,420	
Magnesium	325,000	---			
Manganese	1,600	69,000 / 8,700*	See TCLP/SPLP	See TCLP/SPLP	
Mercury	23	10 / 0.1*	6.4	32	
Nickel	1,600	13,000	700	14,000	
Potassium	---	---			
Selenium	390	---	3.3	3.3	
Silver	390	---	39		
Sodium	---	---			
Thallium	6.3	---	3.4	34	
Vanadium	550	---	980	See TCLP/SPLP	
Zinc	23,000	---	16,000	32,000	

The actual laboratory determined pH values are listed and used for reference purposes.

NDA - No Data Available for this pH range.

All units are mg/Kg unless otherwise noted.

Based on 35 IAC Part 742, Appendix B Table A.

Class I / II objectives based on 35 IAC Part 742, Appendix B Tables C & D.

Bolded/Shaded values exceed the lowest pH specific remediation objective.

Chromium Class I / II objectives based on hexavalent chromium.

* - Construction Worker Inhalation Objective from 35 IAC Part 742, Appendix B Table B.



	Analyte	Concentration of Chemicals in Background Soils			
		City of Chicago	Within MSA	Outside MSA	
PNA	Acenaphthene	0.09	0.13	0.04	
	Acenaphthylene	0.03	0.07	0.04	
	Anthracene	0.25	0.40	0.14	
	Benz(a)anthracene	1.1	1.8	0.72	
	Benzo(a)pyrene	1.3	2.1	0.98	
	Benzo(b)fluoranthene	1.5	2.1	0.70	
	Benzo(g,h,i)perylene	0.68	1.7	0.84	
	Benzo(k)fluoranthene	1.0	1.7	0.63	
	Chrysene	1.2	2.7	1.1	
	Dibenz(a,h)anthracene	0.20	0.42	0.15	
	Fluoranthene	2.7	4.1	1.8	
	Fluorene	0.10	0.18	0.04	
	Indeno(1,2,3-cd)pyrene	0.86	1.6	0.51	
	Naphthalene	0.04	0.20	0.17	
	Phenanthrene	1.3	2.5	0.99	
	Pyrene	1.9	3.0	1.2	
INORG	Aluminum		9,500	9,200	
	Antimony		4.0	3.3	
	Arsenic		13.0	11.3	
	Barium		110	122	
	Beryllium		0.59	0.56	
	Cadmium		0.6	0.50	
	Calcium		9,300	5,525	
	Chromium		16.2	13.0	
	Cobalt		8.9	8.9	
	Copper		19.6	12.0	
	Cyanide		0.51	0.50	
	Iron		15,900	15,000	
	Lead		36.0	20.9	
	Magnesium		4,820	2,700	
	Manganese		636	630	
	Mercury		0.06	0.05	
	Nickel		18.0	13.0	
	Potassium		1,268	1,100	
	Selenium		0.48	0.37	
	Silver		0.55	0.50	
	Sodium		130	130.0	
	Thallium		0.32	0.42	
	Vanadium		25.2	25.0	
	Zinc		95.0	60.2	

MSA - Metropolitan Statistical Area

All units are mg/Kg unless otherwise noted.

Based on 35 IAC Part 742, Appendix A Table G and Table H.

Bolded/Shaded values exceed the within MSA background level.

STAT - WATER METHOD DETECTION LIMITS, REPORTING LIMITS, AND MDEQ RESIDENTIAL CRITERIA

Illinois GROUNDWATER						
ANALYTE (& EPA METHOD)	CAS #	MDL	MRL	Residential Generic	MS/MSD % R	MS/MSD % RPD
METALS (6010)		mg/L	mg/L	Cleanup Critiria mg/L		
ALUMINUM	7429-90-5			----		
ANTIMONY	7440-36-0			0.006		
ARSENIC	7440-38-2			0.05		
BARIUM	7440-39-3			2		
BERYLLIUM	7440-41-7			0.004		
CADMIUM	7440-43-9			0.005		
CALCIUM	7440-70-2			----		
CHROMIUM	7440-47-3			0.1		
COBALT	7440-48-4			1		
COPPER	7440-50-8			0.65		
IRON	7439-89-6			5		
LEAD	7439-92-1			0.0075		
MAGNESIUM	7439-95-4			----		
MANGANESE	7439-96-5			0.15		
MERCURY (7470)	7439-97-6			0.002		
NICKEL	7440-02-0			0.1		
POTASSIUM				----		
SELENIUM	7782-49-2			0.05		
SILVER	7440-22-4			0.05		
SODIUM	7440-23-5			----		
THALLIUM	7440-28-0			0.002		
VANADIUM	7440-62-2			0.049		
ZINC	7440-66-6			5		
CYANIDE (7196)	57-12-5			0.2		
HEXAVALENT CHROMIUM (9010)	18540-29-9			----		

STAT - WATER METHOD DETECTION LIMITS, REPORTING LIMITS, AND MDEQ RESIDENTIAL CRITERIA

Illinois GROUNDWATER						
ANALYTE (& EPA METHOD)	CAS #	MDL	MRL	Residential Generic	MS/MSD % R	MS/MSD % RPD
SEMIVOLATILES (8207)		mg/L	mg/L	Cleanup Criteria mg/L		
1,2-Dichlorobenzene	95-50-1			0.6		
1,2,4-Trichlorobenzene	120-82-1			0.07		
1,3-Dichlorobenzene	541-73-1					
1,4-Dichlorobenzene	106-46-7			0.0075		
2,2'oxybis (1-Chloropropane)	108-60-1					
2,4,5-Trichlorophenol	95-95-4			0.7		
2,4,6-Trichlorophenol	88-06-2			0.01		
2,4-Dichlorophenol	120-83-2			0.021		
2,4-Dimethylphenol	105-67-9			0.14		
2,4-Dinitrophenol	51-28-5			0.014		
2,4-Dinitrotoluene	121-14-2			0.00002		
2,6-Dinitrotoluene	606-20-2			0.00031		
2-Chloronaphthalene	91-58-7					
2-Chlorophenol	95-57-8			0.035		
2-Methylnaphthalene	91-57-6					
2-Methylphenol (o-Cresol)	95-48-7			0.35		
2-Nitroaniline	88-74-4					
2-Nitrophenol	88-75-5					
3-Nitroaniline	99-09-2					
3,3-Dichlorobenzidine	91-94-1			0.02		
3&4-Methylphenol (m&p-cresol)	106-44-5					
4,6-Dinitro-2-methylphenol	534-52-1					
4-Bromophenylphenyl ether	101-55-3					
4-Chloro-3-methylphenol	59-50-7					
4-Chloroaniline	106-47-8			0.028		
4-Chlorophenylphenyl ether	7005-72-3					
4-Nitroaniline	100-01-6					
4-Nitrophenol	100-02-7					

STAT - WATER METHOD DETECTION LIMITS, REPORTING LIMITS, AND MDEQ RESIDENTIAL CRITERIA

Acenaphthene	83-32-9			0.42		
Acenaphthylene	208-96-8					
Anthracene	120-12-7			2.1		
Benzo(a)anthracene	56-55-3			0.00013		
Benzo(a)pyrene	50-32-8			0.0002		
Benzo(b)fluoranthene	205-99-2			0.00018		
Benzo(ghi)perylene	191-24-2					
Benzo(k)fluoranthene	207-08-9			0.00017		
bis(2-Chloroethoxy)methane	111-91-1					
bis(2-Chloroethyl)ether	111-44-4			0.01		
bis(2-Ethylhexyl)phthalate	117-81-7			0.006		
Butyl benzyl phthalate	85-68-7			1.4		
Carbazole	86-74-8			----		
Chrysene	218-01-9			0.0015		
Dibenzo(a,h)anthracene	53-70-3			0.0003		
Dibenzofuran	132-64-9					
Diethylphthalate	84-66-2			5.6		
Dimethylphthalate	131-11-3					
Di-n-butylphthalate	84-74-2					
Di-noctylphthalate	117-84-0			0.14		
Fluoranthene	2063-44-0			0.28		
Fluorene	86-73-7			0.28		
Hexachlorobenzene	118-74-1			0.00006		
Hexachloro-1,3-butadine	87-68-3					
Hexachlorocyclopentadiene	77-47-4			0.05		
Hexachloroethane	67-72-1			0.007		
Indeno(1,2,3-cd)pyrene	193-39-5			0.00043		
Isophorone	78-59-1			1.4		
Naphthalene	91-20-3			0.14		
Nitrobenzene	98-95-3			0.0035		
N-Nitroso-di-n-propylamine	621-64-7			0.0018		
N-Nitrosodiphenylamine	86-30-6			0.0032		
Pentachlorophenol	87-86-5			0.001		
Phenanthrene	85-01-8					
Phenol	108-95-2			0.1		
Pyrene	129-00-0			0.21		

STAT - WATER METHOD DETECTION LIMITS, REPORTING LIMITS, AND MDEQ RESIDENTIAL CRITERIA

Illinois GROUNDWATER						
ANALYTE (& EPA METHOD)	CAS #	MDL	MRL	Residential Generic	MS/MSD % R	MS/MSD % RPD
VOLATILES (8260)		mg/L	mg/L	Cleanup Critiria mg/L**		
1,1,1-Trichloroethane	71-55-6			0.2		
1,1,2,2-Tetrachloroethane	79-34-5					
1,1,2-Trichloroethane	79-00-5			0.005		
1,1-Dichloroethane	75-34-3			0.7		
1,1-Dichloroethylene	75-35-4			0.007		
1,2-Dichlorobenzene	95-50-1			0.6		
1,2-Dichloroethane	107-06-2			0.005		
1,2-Dichloropropane	78-87-5			0.005		
1,3-Dichlorobenzene	541-73-1					
1,4-Dichlorobenzene	106-46-7			0.075		
2-Butanone (MEK)	78-93-3					
2-Hexanone	591-78-6					
4-Methyl-2-pentanone (MIBK)	108-10-1					
Acetone	67-64-1			0.7		
Benzene	71-43-2			0.005		
Bromodichloromethane	75-27-4			0.0002		
Bromoform	75-25-2			0.001		
Bromomethane	74-83-9					
Carbon Disulfide	75-15-0			0.7		
Carbon tetrachloride	56-23-5			0.005		
Chlorobenzene	108-90-7			0.1		
Chloroethane	75-00-3					
Chloroform	67-66-3			0.0002		
Chloromethane	74-87-3					
cis-1,2-Dichloroethene	156-59-2			0.07		
1,3-Dichloropropene	542-75-6			0.001		
Dibromochloromethane	124-48-1					
Ethylbenzene	100-41-4			0.7		
Methyl-tert-butyl ether	1634-04-4			0.07		
Methylene Chloride	75-09-2			0.005		
Styrene	100-42-5			0.1		
Tetrachloroethene	127-18-4			0.005		
Toluene	108-88-3			1		
trans-1,2-Dichloroethene	156-60-5			0.1		
Trichloroethene	79-01-6			0.005		
Vinyl Chloride	75-01-4			0.002		
Total Xylene	1330-20-7			10		
Other:						
DRO (8015)						
GRO (8015)						

** Residential commercial drinking water criterial & RPSLs

GSI= GW SW Interface

STAT - WATER METHOD DETECTION LIMITS, REPORTING LIMITS, AND MDEQ RESIDENTIAL CRITERIA

Illinois GROUNDWATER						
ANALYTE (& EPA METHOD)	CAS #	MDL	MRL	Residential Generic	MS/MSD % R	MS/MSD % RPD
PESTICIDES (8081)		mg/L	mg/L	Cleanup Criteria mg/L		
4,4'-DDD	72-54-8			0.014		
4,4'-DDE	72-55-9			0.01		
4,4'-DDT	50-29-3			0.006		
Aldrin	309-00-2			0.014		
a-BHC	319-84-6			0.00011		
a-Chlordane	5103-71-9					
b-BHC	319-85-7					
d-BHC	319-86-8					
Dieldrin	60-57-1			0.009		
Endosulfan I	959-98-8					
Endosulfan II	33213-65-9					
Endosulfan sulfate	1031-07-8					
Endrin	72-20-8			0.002		
Endrin Aldehyde	7421-93-4					
Endrin ketone	53494-70-5					
g-BHC	58-89-9			0.0002		
g-Chlordane	5566-34-7					
Heptachlor	76-44-8			0.0004		
Heptachlor Epoxide	1024-57-3			0.0002		
4,4'-Methoxychlor	72-43-5			0.04		
Toxaphene	8001-35-2			0.003		

STAT - WATER METHOD DETECTION LIMITS, REPORTING LIMITS, AND MDEQ RESIDENTIAL CRITERIA

Illinois GROUNDWATER						
ANALYTE (& EPA METHOD)	CAS #	MDL	MRL	Residential Generic	MS/MSD % R	MS/MSD % RPD
PCBs EPA (8082)		mg/L	mg/L	Cleanup Criteria mg/L		
Aroclor 1016	12674-11-2					
Aroclor 1221	11104-28-2					
Aroclor 1232	11141-16-5					
Aroclor 1242	53469-21-9					
Aroclor 1248	12672-29-6					
Aroclor 1254	11097-69-1					
Aroclor 1260	11096-82-5					

STAT - WATER METHOD DETECTION LIMITS, REPORTING LIMITS, AND MDEQ RESIDENTIAL CRITERIA

Illinois GROUNDWATER						
ANALYTE (& EPA METHOD)	CAS #	MDL	MRL	Residential Generic	MS/MSD % R	MS/MSD % RPD
HERBICIDES (8151)		mg/L	mg/L	Cleanup Critiria mg/L		
2,4,5-T	93-76-5					
2,4,5-TP Silvex	93-72-1			0.05		
2,4-D	94-75-7			0.07		
2,4-DB	94-82-6					
Dicamba	1918-00-9					
Dichloroprop	120-36-5					
Dinoseb	88-85-7			0.007		
MCPA	94-74-6					

TABLE 3B

LABORATORY PRECISION AND ACCURACY VALUES

TABLE 3b
QA Objectives for Laboratory Parameters
Town of Cicero

Matrix Spike Recovery and Relative Percent Difference Limits (RPD)				
	%Recovery		%RPD	
	Water	Soil	Water	Soil
Metals and Cyanide	75-125	75-125	20	20
Volatile Organic Compounds				
1,1-Dichloroethene	61-145	59-173	14	22
Trichloroethene	71-120	62-137	14	23
Benzene	76-127	66-142	11	21
Toluene	76-125	59-139	13	21
Chlorobenzene	75-130	60-133	13	21
Pesticides/PCBs				
γ-BHC (Lindane)	56-123	46-127	15	50
Heptachlor	40-131	35-130	20	31
Aldrin	40-120	34-132	22	43
Dieldrin	52-126	31-134	18	38
Endrin	56-121	42-139	21	45
4,4'-DDT	38-127	23-134	27	50
Semivolatile Organic Compounds				
Phenol	12-110	26-90	42	35
2-Chlorophenol	27-123	25-102	40	50
1,4-Dichlorobenzene	36-97	28-104	28	27
N-Nitroso-di-N-propylamine	41-116	41-126	38	38
1,2,4-Trichlorobenzene	39-98	38-107	28	23
4-Chloro-3-Methylphenol	23-97	26-103	42	33
Acenaphthene	46-118	31-137	31	19
4-Nitrophenol	10-80	11-114	50	50
2,4-Dinitrotoluene	24-96	28-89	38	47
Pentachlorophenol	9-103	17-109	50	47
Pyrene	26-127	35-142	31	36

TABLE 4

QA/QC SAMPLE REQUIREMENTS

Table 4
Field and Lab QA/QC Sample Requirements
Brownfields Assessment Project
Project Name: Town of Cicero Brownfield Assessment Grant

	QC Sample Type	Frequency of Sample/Analysis	Details
Field Samples	Duplicate Samples	1 duplicate per 20 samples per matrix, or 1 duplicate per sample matrix if fewer than 20 samples	Duplicate sample to be collected by the same methods at the same time as the original sample. Used to verify sample and analytical reproducibility.
	Equipment Blanks	1 equipment blank per 20 samples, minimum 1 equipment blank per day per sample matrix	Distilled water placed into contact with sampling equipment. Used to assess quality of data from field sampling and decontamination procedures.
	Trip Blanks	1 trip blank per cooler containing samples for VOC analysis for water samples	Laboratory prepared organic-free blank to assess potential contamination during sample container shipment and storage.
		1 trip blank per site or per lot of bottles for soils	If soil VOC samples are to be preserved with methanol and/or sodium bisulfate, one set of preserved vials will be included to assess potential contamination during sample container shipment and storage.
Lab Samples	Matrix Spike/ Matrix Spike Duplicate	1 MS/MSD per 20 or fewer samples per matrix	Laboratory spiked sample to evaluate matrix and measurement methodology.
	Method Blanks	1 method blank per batch of samples prepared, or per lab SOP	Laboratory blank sample to assess potential for contamination from laboratory instruments or procedures.
	Laboratory Control Samples and Duplicates	Analyzed as per method requirements and laboratory SOPs	Evaluates laboratory reproducibility.

TABLE 5

**SAMPLE CONTAINER, PRESERVATION, AND HOLDING TIME
REQUIREMENTS**

Table 5 – Revision 2
Sample Container, Preservation and
Holding Time Requirements

Ma- trix	Analysis	Container	Preservation	Holding Time
S O I L	Metals	1 – 4 oz glass jar	Cool to 4° C	6 months; mercury 28 days; chromium VI 24 hours
	Volatile Organic Compounds	2 – 40 ml glass vials and with 10 grams of soil each	methanol, Cool to 4° C	14 days
	Volatile Organic Compounds using EnCore sampling methods	2 EnCore tubes or sampling devices	Cool to 4° C, requires preservation at the lab within 48 hours of collection	14 days
	Semivolatile Organic Compounds	1 – 4 oz glass jar	Cool to 4° C	14 days
	Total Petroleum Hydrocarbons GRO/DRO	1 – 4 oz glass jar	Cool to 4° C	14 days
	DRO	1 – tarred 4 oz glass jar with 25 grams of soil	Cool to 4° C	14 days
	GRO	2 – 40 ml glass vials and with 10 grams of soil each	methanol, Cool to 4° C	14 days
	Pesticides, Herbicides and PCBs	1 – 4 oz glass jar	Cool to 4° C	14 days
	Cyanide, Total	1 – 4 oz glass jar	Cool to 4° C	14 days
W A T E R	Metals, Total and Field Filtered	1 – 500 ml plastic bottle <i>Separate bottle for CrVI+ due to short holding time</i>	HNO3 to pH<2, cool to 4° C	6 months; mercury 28 days; CR VI + is 24 hours
	Low level mercury (Method 1631)	1 – 250 ml glass bottle	BrCl to pH<2 - preserved within 48 hours at lab Cool to 4° C	28 days after preservation
	Volatile Organic Compounds	3 – 40 ml level 2 glass vials	Cool to 4° C HCl to pH <2	14 days
	Semivolatile Organic Compounds	1 – 1 L level 2 amber glass bottle	Cool to 4° C	7 days
	Polynuclear Aromatic Compounds	1 – 1 L level 2 amber glass bottle	Cool to 4° C	7 days
	Pesticides, Herbicides and PCBs	1 – 1 L level 2 amber glass bottle each	Cool to 4° C	7 days
	Cyanide, Total	1 – 1 L level 2 glass bottle	NaOH to pH>12, 0.6 g Ascorbic Acid*	14 days
Bulk	Asbestos	Resealable baggie	None	None
Paint Chips	Lead	Resealable baggie	None	None
Air	TO 14 VOCs	Summa Canister	None	7 days

TABLE 6

**FIELD EQUIPMENT MAINTENANCE PROCEDURES AND QA
OBJECTIVES**

PREVENTATIVE MAINTENANCE

TABLE 6

INSTRUMENTS	MAINTENANCE PROCEDURES/SCHEDULE	SPARE PARTS IN STOCK
Photovac MicroTIP Photoionization Detector	1. Calibrate beginning and end of each day and as necessary during use. 2. Check battery, and recharge when low. 3. Clean lamp window every 24 hours of operation. 4. Replace dust filter every 240 hours of operation. 5. Replace sample pump every 5000 hours of operation.	1. Battery charger 2. Spare lamps 3. Spare filter cartridges
Thermo Environmental Model 580B Photoionization Detector	1. Calibrate beginning and end of each day, and as necessary during use. 2. Check battery, and recharge when low. 3. Clean lamp and dust filter as needed. 4. Replace water traps if they become wet.	1. Spare lamps 2. Spare dust filters.
Field Gas Chromatograph	1. Change injector septa daily. 2. Repack column when separation and linearity becomes poor. 3. Clean PID lamp before each initial calibration; change when sensitivity lost. 4. Clean injector port/liner weekly.	1. Septa 2. Empty columns and column packing 3. PID lamps 4. Injector lines
pH Meter	1. Calibrate beginning and end of each day, and as necessary during use. 2. Replace electrodes as needed.	1. pH buffers 2. Batteries 3. Spare electrodes
Conductivity Meter	1. Calibrate beginning and end of each day, and as necessary during use. 2. Check redline and replace batteries if does not calibrate.	1. Batteries
HNu Model Photoionization Detector	1. Calibrate beginning and end of each day, and as necessary during use. 2. Check battery, and recharge when low. 3. Clean UV lamp, ion chamber, and fan if calibration falls outside 10% of the calibration standard, or if readings are erratic.	1. Battery charger 2. Spare lamps

QA OBJECTIVES FOR FIELD MEASUREMENTS

PARAMETER	METHOD ⁽¹⁾ REFERENCE	PRECISION ⁽²⁾	ACCURACY ⁽³⁾	COMPLETENESS
WATER				
Standing Water Levels	Solinist Water Level Indicator	±0.01 ft.	0.005 ft.	95%
Temperature	E170., Mercury Thermometer or Electronic Temperature Probe	±0.5°C	1.0°C	95%
Conductivity	E120.1, Electrometric	±25	10 umho/cm ²	95%
pH	E150.1, Electrometric	±0.1 pH units	0.05 pH units	95%
Turbidity	E180.1	10 NTU ⁽⁴⁾	0.5 NTU ⁽⁴⁾	95%
Redox Potential	ASTM 1498-93	±10mV	10 mV	95%
Dissolved Oxygen	SM-A4500	±0.05 mg/L	±0.1 mg/L	95%
SOIL				
Bulk Density	ASTM D-1556	NPM	NPM	95%
Soil pH	SW-9045	±0.1 pH units	0.05 pH units	95%

NOTES:

- Methods: E - *Method for Chemical Analysis for Water and Wastes* (U.S. EPA, 1983).
SW - *Test for the Evaluation of Solid Waste*, SW-846, U.S. EPA, September 1986.
SM - *Standard Methods for Examination of the Water and Wastewater*, 18th ed. (APHA, 1992).
ASTM - *Annual Book of ASTM Standards*, American Society of Testing and Materials, 1995.
- Expressed as the acceptable deviation from the Scale.
- Expected based on equipment manufacturer specifications.
- Acceptable accuracy and precision based on the range of measured. NTUs(nephelometric turbidity units). NPM - Not Part of Method

TABLE 6

APPENDIX A

K-PLUS RESUMES

Daniel M. Caplice, P.E.

Academic/Educational

M.M., Finance and Managerial Economics, J.L. Kellogg Graduate School of Management, Northwestern University, Chicago.

M.P.H., Industrial Hygiene and Safety Engineering, University of Illinois at Chicago.

B.S., Civil Engineering, University of Illinois at Urbana-Champaign.

Registered Professional Engineer, Illinois, Indiana, Iowa, Minnesota, Michigan, Ohio, Wisconsin, Missouri, North Carolina, Kentucky, Pennsylvania, Florida, and Louisiana (pending).

Registered AHERA Building Inspector/Management Planner, Illinois.

Registered LUST Site Assessor, Wisconsin and Indiana

Experience

Mr. Caplice has worked extensively in the environmental field for the past 21 years. He has served as a consulting environmental engineer for various private, public, and non-profit institutions and he worked in several different capacities for the United States Environmental Protection Agency. His responsibilities have included directing and managing various projects, particularly voluntary cleanups, underground storage tank remediations, and National Priority List (NPL) evaluations, investigations, and cleanups. Contamination at these properties have included all variety of chemical, biological, and radioactive agents.

For the past 16 years, he has served as a consulting environmental engineer for numerous private, public, and non-profit institutions. As a consultant, his responsibilities have included designing directing various projects, particularly investigations, evaluations, cleanups of contaminated facilities and contaminated soil and ground water. Mr. Caplice has worked extensively on the investigation and cleanup of numerous active and abandoned industrial facilities, landfills, and other waste sites. He has also served as the project manager or senior technical advisor on hundreds of environmental projects at a multitude of sites, from small, undeveloped parcels of property to multi-location industrial facilities. Finally, Mr. Caplice has served as a technical expert on issues pertaining to the investigation and remediation of contaminated property as well as permit issues related to manufacturing facilities.

Areas of expertise include the evaluation of the environmental aspects of manufacturing operations and the waste and emissions that are or may be generated by those operations; environmental assessment and evaluation of contaminated real estate and businesses, remediation and closure of contaminated soil and ground water; permitting emissions and discharges from industrial facilities; and technical negotiations for the investigation and cleanup of hazardous waste sites.

Mr. Caplice also has experience in the regulatory analysis of projects for compliance with federal and state environmental regulations, guidance, protocols, and procedures. His environmental regulatory experience includes evaluating compliance of private party actions, reviewing and preparing comments on proposed environmental laws and administrative rules, reviewing site documents and preparing detailed comments, and serving as a technical expert in various environmental cases.

Terrence J. O'Brien

Academic/Educational

B.A., Sociology, John Carroll University, Cleveland, Ohio.

C.E.I., Certified Environmental Inspector (7365), Scottsdale, Arizona.

Confined Space and Rescue Training, Certification # 92-043-CR.

OSHA 1910.120, 40 Hour health and safety training.

First Aid Training.

Experience

Mr. O'Brien has extensive experience in hazardous material cleanups and hazardous waste management from both the technical and regulatory viewpoints. Areas of expertise include the packing of Special Waste, RCRA Waste and TSCA Waste; the proper identification, labeling and manifesting required by the Department of Transportation (DOT); and the investigation of the best available technology for the treatment and disposal of Special Waste, RCRA Waste and TSCA Waste. He regularly provides guidance and assistance to utilities, private, public, and non-profit institutions in meeting their waste handling requirements. His knowledge of industrial processes, federal, state and local environmental regulations, and his experience in industrial cleanups, gives him a comprehensive understanding of the unique challenges faced by industrial managers.

Prior to joining K-Plus, Mr. O'Brien was a Senior Account Executive with a private environmental firm specializing in waste permitting for the treatment and transportation of hazardous, non-hazardous and PCB waste materials. During that time, Mr. O'Brien also served as a project manager for numerous remediation projects at industrial facilities. These projects have ranged from simple closure of underground storage tanks and remediation of contaminated soil and ground water to complex on-site waste stabilization projects at active industrial facilities.

Prior to his career in the private sector, Mr. O'Brien served as a Pollution Control Officer (PCO) with the Metropolitan Water Reclamation District of Greater Chicago, where he was responsible for inspecting industrial waste water pre-treatment facilities and supervising private cleanups of toxic and hazardous material spills. As a PCO he also enforced the MWRDGC Sewage and Waste Control Ordinance, and he acted as a liaison between the MWRDGC and industrial management personnel dealing with the User Charge Ordinance and the verification of statistical data submitted by private, public and non-profit institutions.

As Director of Sales and Service for K-Plus Environmental, Mr. O'Brien is responsible for coordinating the account executives and the technical staff in order to provide K-Plus customers with the highest level of service and communication. His technical industry experience and his proven ability to work well with industrial clients have served him well in this demanding position.



James L. Loring, P.G., R.E.A.

Academic/Educational

Bachelor of Science, Geology, Eastern Illinois University, 1982

Professional Geologist – Illinois, Indiana, Kentucky, Pennsylvania, Tennessee, Wisconsin

Registered Environmental Assessor I (REA I) – California

AHERA Building Inspector

OSHA 29 CFR 1910.120 40-Hour Hazardous Waste Training

OSHA 29 CFR 1910.120 8-Hour Hazardous Waste Training

Experience

Mr. Loring is a Manager-Partner for K-Plus Environmental in Chicago, Illinois. He is responsible for technical and QA/QC aspects of projects, directing and reviewing work of others, and meeting project schedules and budgets. He specializes in site assessment work for Commercial Mortgage Backed Securities (CMBS) and has work experience throughout the United States and Canada. He has extensive experience in managing, planning and performing exploration for a variety of geo-environmental projects in regions of widely varying geologic conditions. His skills include all aspects of field investigations, analysis of field and laboratory data by manual and/or computer analysis, regulatory and scientific research, preparation of reports to present data and conclusions, negotiating with regulatory agencies, and preparation of proposals and cost estimates. He has experience completing Property Condition Assessments for residential, commercial and industrial properties and has completed the ASTM E2018 Property Condition Assessment Training Course. He is experienced in and has performed presentations and testimony on a variety of legal issues; planning and zoning hearings and public forum discussions for local, regional and state projects. He provides AIA continuing education presentations and participates in local high school and university educational mentoring programs.

Underground and Aboveground Storage Tanks. Mr. Loring has performed compliance reviews for UST and AST facilities; prepared installation, removal and demolition plans and specifications for USTs; and prepared Spill Prevention Control and Countermeasure (SPCC) Plans and Oil Discharge Contingency Plans (ODCPs). He has performed tank upgrade evaluations, tank removal monitoring, closure assessments, contamination and remediation assessments, and has prepared site classification reports, exposure assessments and corrective action plans (CAPs). He is experienced in preparing reimbursement packages for state trust funds.

Remedial Action/Remediation Design. Mr. Loring has performed remediation assessments, feasibility and cost evaluations, plans and specifications, and field monitoring. Remediation experience includes natural attenuation, excavation with off-site disposal, bioremediation, bio-piles, in-situ containment, air sparging and vapor extraction, dual-phase extraction, groundwater extraction and treatment, and incineration.



James L. Loring, P.G., R.E.A.
(Continued)

Environmental Site Assessments and Environmental Compliance Audits. Mr. Loring has completed site assessments project throughout the U.S. Work involved site history review, regulatory database and local record review, site and area reconnaissance lead, radon and asbestos sampling, and report preparation. Site Exploration or Phase II environmental site evaluations have included environmental subsurface investigation of soils and groundwater contaminants. He has also completed Compliance Audits for public organizations and corporate clients at various industrial facilities.

Field Testing and Sampling. Mr. Loring has performed investigations that have included hollow stem and solid flight auger soil borings, pneumatic hammer and tri-cone rock bit drilling, reverse circulation drilling, monitoring well placement, soil gas surveys, geoprobe, test pits and geophysical surveys, soil gas surveys, radon testing, rock coring and down hole packer testing, soil sampling, potable water well design and construction, aquifer testing, groundwater monitoring, chemical fate and transport assessments, and risk assessments. He has completed preparation of health and safety plans and conducted Indoor Air Quality surveys and EM field surveys. He has experience with various IAQ testing methodologies including microbiological.

Indoor Air Quality. Mr. Loring has completed numerous Indoor Air Quality reviews including ventilation studies, lead paint monitoring, and microbiological studies. He provided management and air quality reviews for Chicago Loop office buildings during the 1993 flooding. He has completed reviews for residential, industrial and hospital clients.

RCRA/CERCLA/Compliance/Closure. Mr. Loring has managed and performed numerous hazardous waste and contamination assessments, permit preparations, groundwater monitoring programs, remediation assessments and remedial actions. Projects include sites impacted with chlorinated solvents, release from hazardous waste UST containing TCE, investigation and preparation of a RCRA Part B Permit for hazardous waste storage areas, the investigation of buried hazardous waste containers, closure of landfills, and the remediation of PCB contaminated sites. Mr. Loring has prepared management and response plans for storm water management, pollution prevention, spill prevention, control and countermeasure (SPCC) plans, oil discharge contingency plans (ODCP), hazardous waste contingency plans, and RCRA audits. His responsibilities have included permit preparations, recommendations for management practices, and sampling and analysis of results for monitoring programs.

Natural Resources Services. Mr. Loring has performed wetland identification, delineation following U.S. Army Corps of Engineers procedures. He has experience in delineating different varieties of wetland ecosystems and has experience with Federal and State permitting requirements and regulations. He has completed numerous NEPA site reviews and report submittals including Environmental Assessments (EAs) for wetland, floodplain, archeological surveys endangered plant and wildlife and historical structure evaluation.



James L. Loring, P.G., R.E.A.
(Continued)

Mineral Resource Development. Mr. Loring has completed mineral resource exploration and development for oil and gas, coal, sand, gravel and bedrock quarry operations. He has been involved with subsurface and field geological mapping, prospect development and drilling operations in support of mineral development projects. His experience includes drilling with cable tool, mud and air rotary rigs and evaluation of downhole geophysical logs and cores. He has prepared economic analysis of available mineral resources and estimated reserve analysis. His recent mineral resource experience includes evaluation of a 40 acre slag and fly ash dump at a former iron smelting operation.



Kenneth A. Lauber, P.G.

Academic/Educational

Bachelor of Science, Geology, Western Carolina University, 1986
Master of Science, Environmental Systems Engineering, Clemson University, 1992
Registered Professional Geologist in South Carolina (P.G. #2068)
Licensed Geologist in North Carolina (L.G. #1521)
OSHA 29 CFR 1910.120 40-Hour Hazardous Waste Training
OSHA 29 CFR 1910.120 8-Hour Hazardous Waste Training
American Institute of Professional Geologists (MEM#0078)
Carolina Geological Society - Member

Experience

Mr. Lauber is a Manager-Partner for K-Plus Environmental in Greenville, South Carolina. He is responsible for technical and QA/QC aspects of projects, directing and reviewing work of others, and meeting project schedules and budgets. He specializes in site assessment work for Commercial Mortgage Backed Securities (CMBS) and has work experience throughout the United States. He has extensive experience in managing, planning and performing exploration for a variety of geo-environmental projects in regions of widely varying geologic conditions. His skills include all aspects of field investigations, analysis of field and laboratory data by manual and/or computer analysis, regulatory and scientific research, preparation of reports to present data and conclusions, negotiating with regulatory agencies, and preparation of proposals and cost estimates.

Underground and Aboveground Storage Tanks. Mr. Lauber has performed compliance reviews for UST and AST facilities; prepared installation, removal and demolition plans and specifications for USTs; and prepared Spill Prevention Control and Countermeasure (SPCC) Plans. He has performed tank upgrade evaluations, tank removal monitoring, closure assessments, contamination and remediation assessments, and has prepared site classification reports, exposure assessments and corrective action plans (CAPs). He is experienced in preparing reimbursement packages for North Carolina and South Carolina state trust funds.

Remedial Action/Remediation Design. Mr. Lauber has performed remediation assessments, feasibility and cost evaluations, plans and specifications, and field monitoring. Remediation experience includes natural attenuation, excavation with off-site disposal, bioremediation, in-situ containment, air sparging and vapor extraction, dual-phase extraction, groundwater extraction and treatment.

Environmental Site Assessments and Environmental Compliance Audits. Mr. Lauber has completed site assessments project throughout the U.S. Work involved site history review, regulatory database and local record review, site and area reconnaissance lead, radon and asbestos sampling, and report preparation. Site Exploration or Phase II environmental site evaluations have included environmental subsurface investigation of soils and groundwater contaminants.



Kenneth A. Lauber, P.G.
(Continued)

Field Testing and Sampling. Mr. Lauber has performed investigations that have included hollow stem and solid flight auger soil borings, pneumatic hammer and tri-cone rock bit drilling, reverse circulation drilling, monitoring well placement, soil gas surveys, geoprobe, test pits and geophysical surveys, soil gas surveys, radon testing, rock coring and down hole packer testing, soil sampling, potable water well design and construction, aquifer testing, groundwater monitoring, chemical fate and transport assessments, and risk assessments. He has completed preparation of health and safety plans and conducted Indoor Air Quality surveys and EM field surveys. He has experience with various IAQ testing methodologies including microbiological.

Indoor Air Quality. Mr. Lauber has completed numerous Indoor Air Quality reviews including ventilation studies, lead paint monitoring, and microbiological studies. He has completed reviews for residential, industrial and hospital clients.

RCRA/CERCLA/Compliance/Closure. Mr. Lauber has managed and performed numerous hazardous waste and contamination assessments; permit preparations, groundwater monitoring programs, remediation assessments and remedial actions. Projects include sites impacted with chlorinated solvents, release from hazardous waste UST containing TCE, investigation and preparation of a RCRA Part B Permit for hazardous waste storage areas, the investigation of buried hazardous waste containers, closure of landfills, and the remediation of PCB contaminated sites. Mr. Lauber has prepared management and response plans for storm water management, pollution prevention, spill prevention, control and countermeasure (SPCC) plans. His responsibilities have included permit preparations, recommendations for management practices, and sampling and analysis of results for monitoring programs.

Natural Resources Services. Mr. Lauber has reviewed wetland identification and delineation following U.S. Army Corps of Engineers procedures. He has experience in delineating different varieties of wetland ecosystems and has experience with Federal and State permitting requirements and regulations. He has completed NEPA site reviews and report submittals including Environmental Assessments (EAs) for wetland, floodplain, archeological surveys endangered plant and wildlife and historical structure evaluation.

Mineral Resource Development. Mr. Lauber has completed mineral resource mapping for gold quarry operations. His experience includes drilling with mud and air rotary rigs and evaluation of downhole geophysical logs and cores. His recent mineral resource experience includes evaluation of quarry wall stability at a former open-pit gold mine near Columbia, SC.



Heather Williams Dawdy

Academic/Educational

Bachelor of Arts, Biological Sciences, Southern Illinois University - Carbondale, Illinois, 1991

Master of Science, Environmental Engineering, Southern Illinois University - Carbondale, Illinois, 1994

OSHA 29 CFR 1910.120 40-Hour Hazardous Waste Training

OSHA 29 CFR 1910.120 8-Hour Hazardous Waste Training

Experience

Ms. Dawdy is a Senior Engineer for K-Plus Environmental in Chicago, Illinois. She specializes in site assessment work for Commercial Mortgage Backed Securities (CMBS) and has work experience throughout the United States and Canada. She has extensive experience in managing, planning and performing exploration for a variety of environmental projects in regions of widely varying geologic condition. Her skills include all aspects of field investigation, analysis of field and laboratory data by manual and/or computer analysis, regulatory and scientific research, preparation of reports to present data and conclusions, negotiating with regulatory agencies, and preparation of proposals and cost estimates.

Environmental Site Assessments and Environmental Compliance Audits. Ms. Dawdy has completed site assessments project throughout the U.S. Work involved site and area reconnaissance, site history review, regulatory database and local record review, lead, radon and asbestos sampling and report preparation. Site Exploration or Phase II environmental site evaluations have included environmental subsurface investigation of soil and groundwater contamination. She has also completed Compliance Audits for public organizations and corporate clients at various industrial facilities.

Field Testing and Sampling. Mr. Dawdy has performed investigations that have included hollow stem and solid flight auger soil borings, pneumatic hammer and tri-cone rock bit drilling, monitoring well placement, geoprobe, test pits and geophysical surveys, radon testing, rock coring, aquifer testing, groundwater monitoring, chemical fate and transport assessments, and risk assessments. She has completed preparation of health and safety plans and conducted Indoor Air Quality surveys and Geophysical field surveys. Ms. Dawdy has completed building façade evaluations and bridge deck delimitation surveys as part of physical building condition surveys.

Underground and Aboveground Storage Tanks. Ms. Dawdy has performed compliance reviews for UST and AST facilities; and prepared installation, removal and demolition plans and specifications for USTs. She has performed tank upgrade evaluations, tank removal monitoring, closure assessments, contamination and remediation assessments, and has prepared site classification reports, exposure assessments and corrective action plans. She is experienced in preparing reimbursement packages for state trust funds.

Remedial Action/Remediation Design. Ms. Dawdy has provided project support associated with remediation assessments, feasibility and cost evaluations, plans and specifications, and field monitoring.



Heather Williams Dawdy

(Continued)

Remediation experience includes natural attenuation, excavation with off-site disposal, bioremediation, bio-piles, in-situ containment, air sparging and vapor extraction, dual-phase extraction, groundwater extraction and treatment, and incineration.

RCRA/CERCLA/Compliance/Closure. Ms. Dawdy has managed and performed numerous hazardous waste and contamination assessments, permit preparations, groundwater monitoring programs, remediation assessments and remedial actions. Projects include sites impacted with chlorinated solvents, release from hazardous waste UST containing TCE, investigation of buried hazardous waste containers, closure of landfills, and the remediation of PCB contaminated sites.

Natural Resources Services. Ms. Dawdy has performed wetland identification, delineation following U.S. Army Corps of Engineers procedures. She has experience in delineating different varieties of wetland ecosystems and has experience with Federal and State permitting requirements and regulations. She has completed numerous NEPA site reviews and report submittals including Environmental Assessments (EAs) for wetland, floodplain, archeological surveys endangered plant and wildlife and historical structure evaluation. Ms. Dawdy is experienced in completing biological surveys for endangered plants and wildlife including Brown Bats, Prairie Grouse, Eastern Timber Rattlesnake, Iowa Snail Darters, and a variety of native and endangered plant species.



SUSAN A. ISKOWICH

Academic/Educational

B.S., Finance, Boston College, Boston, Massachusetts.

J.D. , DePaul University, Chicago, Illinois.

OSHA 1910.120, 40 Hour health and safety training.

Environmental Liabilities in Real Estate Transactions, Chicago Bar Association.

Environmental Legislative Update Seminar, Illinois State Bar Association.

Environmental Insurance for Real Estate Transactions, Chicago Bar Association.

Environmental Sciences Seminar, American Bar Association

Experience

Since joining K-Plus, Ms. Iskowich has been involved with a wide variety of projects including regulatory compliance research, remedial action plan design, and industrial air quality investigations. She has also prepared closure reports, groundwater investigation reports, and corrective action plans for submittal to Agency representatives. Ms. Iskowich has had first hand experience with the CERCLA, RCRA, the Clean Air Act and the LUST and voluntary Brownfield cleanup programs in several states. As a result she is well versed in all of these programs.

Ms. Iskowich has also performed and reviewed hundreds of environmental assessments and compliance audits on a broad range of properties from industrial sites to multi-family residential properties. Specific investigations have included an assessment of a manufacturer of asphalt-based roofing materials with facilities in Illinois and Colorado and a compliance audit of a manufacturing facility in Michigan. Ms. Iskowich has also managed and directed many subsurface soil and ground water investigations. These projects have been both local and national in nature and have included local manufacturing facilities with perchloroethylene contamination in the ground water, a drum manufacturing facility in California with chrome and solvent contamination, a dry cleaner with solvent contamination in the ground water off-site, and a utility company with extensive free product on the water table.

As a Senior Project Consultant for K-Plus, Ms. Iskowich is responsible for coordinating and overseeing numerous ongoing projects. In addition, as part of the K-Plus quality control program, Ms. Iskowich regularly reviews project reports for technical and factual accuracy and adherence to the applicable Agency program requirements

Ms. Iskowich is a member of a variety of organizations which allows her to stay abreast of current state and local laws and policies. Ms. Iskowich's project experience and educational background provide her with the skills necessary to effectively communicate technical concepts and issues to a wide variety of individuals including attorneys, bankers, real estate professionals, and business owners.

Education:

University of Illinois, Urbana-Champaign, Illinois
Bachelor of Science, General Engineering

SELECTED CONTINUING EDUCATION:

OSHA:

- Occupational Safety and Health for Construction Industry Course (OSHA 510)
- OSHA 1910.120, 40 Hour Health and Safety Training for Hazardous Waste Sites
- State of Illinois Department of Health Licensed Asbestos Building Inspector: 100-10513

Other:

- Engineering Design Analysis
- Operations Research Method for Profit and Value Engineering
- Engineering Law
- Environmental Biology
- Geology

As a Project Manager Mr. Colin is responsible for directing and conducting a wide array of field and office activities. In addition, he has prepared applications for air and NPDES permits, as well as written technical reports to ensure compliance and conformance with environmental regulations and guidelines. The technical skills, effective management, and organizational abilities of Mr. Colin have enabled him to work on a variety of projects

Selected Project Involvement

McCook Metals, McCook, IL – On-site Assistant Engineer for the largest single industrial facility in Illinois. Project included managing and coordinating a variety of ongoing environmental projects at the plant. Project also included all recordkeeping related to the National Pollutant Discharge Elimination System, local Publicly Owned Treatment Works discharge authorization, and air emission permits at the plant.

Property Redevelopment, Superior Mini-Mart & Gas Station, Warrenville, IL – Project Manager retained by the Village of Warrenville to investigate the extent of contamination on and off-site from an old gasoline filling station. Project included soil and ground water sampling followed by extensive fate and transport modeling to predict the future migration of the contamination. Upon completion of the investigation and evaluation, selected hot spots were excavated, engineered barriers were installed, and a Highway Authority Agreement was secured with the Illinois Department of Transportation for off-site contamination. Once the Highway Authority Agreement and the necessary site work were completed, the IEPA issued a No Further Remediation (NFR) letter for the site.

Environmental Assessments, FAA Facilities at Various Airports – The FAA hired K-Plus as the prime consultant to study properties in Illinois, Michigan, Indiana, and Wisconsin that the FAA had leased for its LLWAS, Visual Omni Range with Tactical Air Navigation (VORTAC), and Remote Transmitter/Receiver (RTR) equipment sites. The FAA needed the assessments to ensure that its signaling and control equipment locations did not conflict with the NEPA or other federal environmental regulation or have an adverse affect on the subsurface.).



General Electric, Cicero, IL – Lead researcher in a study project for General Electric to develop a more efficient handling system to deliver magnesium oxide insulation into the company's oven-heating coils.

LUST Site Remediation, Avanti Engineering, Bensenville, IL – Provides construction management services for a gravity fed groundwater collection system to capture free product on the water table underneath and adjacent to an active manufacturing facility after the removal of several LUSTs. The project was completed in less than 6 months and the Illinois EPA issued a No Further Remediation letter after reviewing the Corrective Action Completion Report.





Education:

Illinois State University, Normal, Illinois
Bachelor of Science, Environmental Health Sciences

SELECTED CONTINUING EDUCATION:

OSHA:

- Occupational Safety and Health for Construction Industry Course (OSHA 510)
- OSHA 1910.120, 40 Hour Health and Safety Training for Hazardous Waste Sites
- State of Illinois Department of Health Licensed Asbestos Building Inspector: 100-10448
- Erosion and Sediment Control Course 8-hour: AIA Registered

Other:

- Water Quality and Treatment
- Waste Management Practices
- Environmental Toxicology
- Control of Institutional Environments
- Pollution Prevention
- Occupational Health
- Geology/Hydrology/Wetlands Identification

As a Project Manager, Mrs. Madsen is responsible for conducting managing various environmental investigation and remediation projects. Part of this role requires compliance and conformance with national and local environmental regulations and guidelines. Mrs. Madsen has successfully managed a variety of projects in Illinois, Indiana, California, Texas, Michigan, and New York.

Selected Project Involvement

Spill Response Remediation and Restoration, Rancho Cordova, CA – Project Manager for the environmental remediation of a large tract of land contaminated by a spill of PCB-contaminated oil. Because the contamination was on private property not owned by the responsible party, the cleanup objective for the work was total removal of all contamination. Mrs. Madsen directed all onsite removal and restoration activities that were completed. All work was completed on an expedited schedule over a holiday weekend.

SRP Site Closure, Former Industrial Facility, Seneca, IL – Served as Resident Engineer to manage and direct the final phase of an environmental clean up of a former industrial site adjacent to Illinois River. Work involved the testing and removal of soil contaminated pesticides followed by site restoration. K-Plus worked under the supervision of the Illinois EPA during the clean-up effort.

SRP Site Closure, Industrial Facility, Skokie, IL – Leaking tanks identified at an adjacent parcel migrated off-site. An extensive subsurface investigation was completed to determine the horizontal and vertical extents of the soil and ground water contamination. During the investigation, secondary surficial soil contamination was identified on the site due to spillage or dumping from the former adhesives manufacturing operations. The site was closed following fate and transport modeling. The closure was achieved with minimal cost to the owner by utilizing land restrictions and an engineered barrier and without any active remedial activities. Upon review, the IEPA issued a No Further Remediation (NFR) letter for the property.





Leaking Underground Storage Tank Program, Commercial Facility, Melrose Park, IL – During an environmental assessment of the property, it was determined that the prior use of the property was a gasoline station. Following a magnetometer survey that suggested tanks were still present at the property, Mrs. Madsen directed the removal and destruction of the tanks. During removal activities it was determined that one or more of the tanks had experienced a leak, therefore a LUST Incident number was obtained and all affected soils were removed from the property. The site was cleaned to Illinois residential property standards and the Illinois EPA issued a NFR letter with no restrictions.

Environmental and Erosion Control Manager – Mrs. Madsen worked with Walsh Construction on their North-South Tollway Expansion Project. Mrs. Madsen worked with the Illinois Tollway along side numerous Agency representatives to organize and protect the sensitive wetland species, as well as, the Hine's Emerald Dragonfly (endangered) identified in the Des Plaines River Valley during the construction of the I-355 bridge through Lemont, Illinois. The project included the design and implement of a Maintenance Plan, Environmental-Safety Discussion, Dust Control Plan, Pollution Control Plan, as well as, the implement of the Erosion Control Plan, which was prepared and approved by the IEPA, in coordination with the local Agencies.

National Marine. Wetland Monitoring and Ecological Assessment -- This project was located on the Illinois River within a flood plain. The site contained forested and wetland areas and variety of vegetation and wildlife. Mrs. Madsen, Project Scientist, was responsible for performing site characterization and water quality investigations and evaluations. Assisted with the natural resource assessments and monitoring. Performed soil, surface water and groundwater sampling. Completed draft reports for submittal to the USEPA under CERCLA.

Federal Agency Experience – Mrs. Madsen has worked on numerous Phase I Environmental Site Assessments for potential cellular tower sites located throughout the Midwest. As part of these projects Mrs. Madsen was required to complete full NEPA screens on these properties in order to receive a Finding Of No Significant Impact (FONSI) letter from the FAA.

National Experience – Mrs. Madsen has traveled to other states for in order to conduct Phase II Subsurface Investigations such as: New York, Michigan, Indiana and Texas. With the Subsurface Investigations in foreign states it is necessary to comply with the local state or USEPA regulations, especially when looking at the analysis of lab data. Mrs. Madsen has conducted the research behind the regulations in order to learn acceptable chemical limits for the soils in each of these states, as well as completed detailed technical reports which meet those state regulations.



SCOTT SPLITTGERBER

Academic

B.S., Hydrogeology, Western Michigan University, Kalamazoo, Michigan.
OSHA 1910.120, 40-Hour Hazardous Waste Operations and Emergency Response Training.
Radiation Monitoring and Safety Training.
IS-200, Incident Command System, Basic I-200 for Federal Disaster Workers Certification.
NITON X-Ray Fluorescence (XRF) Spectrum Analyzer Training.
First Aid and Cardio Pulmonary Resuscitation (CPR) Training.

Experience

Mr. Splittgerber has worked extensively in the environmental field for the past six years. He has served as a consulting hydrogeologist at various hazardous waste removal sites and site investigations. His responsibilities have included hazardous waste site investigations and site characterizations, multi-media sampling, air monitoring, and oversight of removal contracts. He has developed and implemented Health and Safety, Work, and Sampling Plans and prepared technical reports summarizing field activities and analytical results.

For the past six years, he has served as a consulting hydrogeologist for numerous private and public institutions. His responsibilities have included coordinating cleanups of contaminated soil and groundwater sites for non-time and time critical removal actions, underground storage tank remediation and investigations. Mr. Splittgerber has worked extensively on the investigation, cleanup, and closure of Leaking Underground Storage Tank (LUST), Site Remediation Program (SRP), Air Force Center for Environmental Excellence (AFCEE), U.S. Environmental Protection Agency (U.S. EPA) Superfund Technical Assessment & Response Team (START), and U.S. Army Corps of Engineers (USACE) projects. He has a comprehensive understanding of the statutory requirements of the LUST program, the SRP, and groundwater quality under Illinois Administrative Code (IAC) Sections 732, 740, 742, and 620. He has achieved No Further Remediation (NFR) determinations for numerous petroleum sites using pathway exclusion, institutional controls, and Illinois' Tiered Approach to Corrective Action Objectives (TACO) site-specific remedial objectives.

Areas of expertise include the evaluation of hazardous waste sites, environmental site assessments, removal actions, and the subsequent closure of contaminated properties. Mr. Splittgerber has experience regulatory compliance according to local, federal and state environmental regulations concerning guidance, protocols, and procedures. His environmental regulatory experience includes coordinating removal actions, specifying levels of personal protection equipment (PPE) and action levels for performing various tasks, and specifying appropriate personnel air monitoring, characterizing hazardous wastes for disposal, preparing removal action completion reports, and obtaining NFR determinations at sites.



APPENDIX B

STAT ANALYSIS NELAP AND STAT ANALYSIS NVLAP CERTIFICATES



**STATE OF ILLINOIS
ENVIRONMENTAL PROTECTION AGENCY
NELAP - RECOGNIZED**



ENVIRONMENTAL LABORATORY ACCREDITATION

is hereby granted to

**STAT ANALYSIS CORPORATION
2242 WEST HARRISON STREET
CHICAGO, IL 60612**

**NELAP ACCREDITED
ACCREDITATION NUMBER #100445**



According to the Illinois Administrative Code, Title 35, Subtitle A, Chapter II, Part 186, ACCREDITATION OF LABORATORIES FOR DRINKING WATER, WASTEWATER AND HAZARDOUS WASTES ANALYSIS, the State of Illinois formally recognizes that this laboratory is technically competent to perform the environmental analyses listed on the scope of accreditation detailed below.

The laboratory agrees to perform all analyses listed on this scope of accreditation according to the Part 186 requirements and acknowledges that continued accreditation is dependent on successful ongoing compliance with the applicable requirements of Part 186. Please contact the Illinois EPA Environmental Laboratory Accreditation Program (IL ELAP) to verify the laboratory's scope of accreditation and accreditation status. Accreditation by the State of Illinois is not an endorsement or a guarantee of validity of the data generated by the laboratory.

Ron Turpin
Manager
Environmental Laboratory Accreditation Program

Janet Cruse
Accreditation Officer
Environmental Laboratory Accreditation Program

Certificate No.: 001853
Expiration Date: 09/30/2008
Issued On: 09/19/2007

State of Illinois
Environmental Protection Agency

Certificate No.:

001853

Awards the Certificate of Approval

STAT Analysis Corporation
2242 West Harrison Street
Chicago, IL 60612

According to the Illinois Administrative Code, Title 35, Subtitle A, Chapter II, Part 186, ACCREDITATION OF LABORATORIES FOR DRINKING WATER, WASTEWATER AND HAZARDOUS WASTES ANALYSIS, the State of Illinois formally recognizes that this laboratory is technically competent to perform the environmental analyses listed on the scope of accreditation detailed below.

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Hazardous and Solid Waste, Inorganic

1010

Ignitability

1311

TCLP (Organic and Inorganic)

1312

Synthetic Precipitation Leaching Procedure

6020

Aluminum

Antimony

Arsenic

Barium

Beryllium

Boron

Cadmium

Calcium

Chromium

Cobalt

Copper

Iron

Lead

Magnesium

Manganese

Molybdenum

Nickel

Potassium

Selenium

Silver

Sodium

Thallium

Vanadium

Zinc

7196A

Chromium VI

7420

Lead

7470A

Mercury

7471A

Mercury

9012A

Cyanide

9040B

Hydrogen Ion (pH)

9045C

Hydrogen Ion (pH)

9066

Phenolics

9095A

Paint Filter

Chapter 7/9012A

Reactive Cyanide

State of Illinois Environmental Protection Agency

Certificate No.:

001853

Awards the Certificate of Approval

STAT Analysis Corporation
2242 West Harrison Street
Chicago, IL 60612

Hazardous and Solid Waste, Inorganic

Reactive Sulfide

Chapter 7/9034

Hazardous and Solid Waste, Organic

8015B

Diesel range organics (DRO)

Gasoline range organics (GRO)

8081A

4,4'-DDD

4,4'-DDE

4,4'-DDT

Aldrin

alpha-BHC

alpha-Chlordane

beta-BHC

Chlordane - not otherwise specified

delta-BHC

Dieldrin

Endosulfan I

Endosulfan II

Endosulfan sulfate

Endrin

Endrin aldehyde

Endrin ketone

gamma-BHC (Lindane)

gamma-Chlordane

Heptachlor

Heptachlor epoxide

Hexachlorobenzene

Methoxychlor

Toxaphene

8082

PCB-1016

PCB-1221

PCB-1232

PCB-1242

PCB-1248

PCB-1254

PCB-1260

8260B

1,1,1,2-Tetrachloroethane

1,1,1-Trichloroethane

1,1,2,2-Tetrachloroethane

1,1,2-Trichloroethane

1,1-Dichloroethane

1,1-Dichloroethene

1,1-Dichloropropene

1,2,3-Trichlorobenzene

1,2,3-Trichloropropane

1,2,4-Trichlorobenzene

1,2,4-Trimethylbenzene

1,2-Dibromo-3-chloropropane (DBCP)

1,2-Dibromoethane (EDB)

1,2-Dichlorobenzene

1,2-Dichloroethane

1,2-Dichloropropane

1,3,5-Trimethylbenzene

1,3-Dichlorobenzene

1,3-Dichloropropane

1,4-Dichlorobenzene

1,4-Dioxane

2,2-Dichloropropane

2-Butanone (Methyl ethyl ketone, MEK)

2-Chloroethyl vinyl ether

2-Chlorotoluene

2-Hexanone

2-Methyl-1-propanol (Isobutyl alcohol)

2-Nitropropane

2-Propanol (Isopropyl alcohol)

4-Chlorotoluene

4-Methyl-2-pentanone (Methyl isobutyl ketone, I

Acetone

Acrolein (Propenal)

Acrylonitrile

Benzene

Bromobenzene

Bromochloromethane

Bromodichloromethane

Bromoform

Bromomethane

Carbon disulfide

Carbon tetrachloride

Chlorobenzene

Chlorodibromomethane (Dibromochloromethane)

Chloroethane

Chloroform

Chloromethane

cis-1,2-Dichloroethene

cis-1,3-Dichloropropene

Dibromomethane

Dichlorodifluoromethane

Dichloromethane (Methylene chloride)

Diethyl ether

Ethyl acetate

Ethyl ether

Ethylbenzene

Hexachlorobutadiene

Isopropylbenzene

Methyl ethyl ketone

Methyl isobutyl ketone

Methyl-t-butyl ether

m-Xylene

Naphthalene

n-Butanol

n-Butylbenzene

o-Xylene

p-Isopropyltoluene

p-Xylene

sec-Butylbenzene

Styrene

tert-Butylbenzene

Tetrachloroethene

Toluene

trans-1,2-Dichloroethene

trans-1,3-Dichloropropene

Trichloroethene

Trichlorofluoromethane

Trichlorotrifluoroethane

Vinyl acetate

Vinyl chloride

Xylenes (Total)

State of Illinois
Environmental Protection Agency

Certificate No.:

001853

Awards the Certificate of Approval

STAT Analysis Corporation
2242 West Harrison Street
Chicago, IL 60612

Hazardous and Solid Waste, Organic

8270C

1,2,4-Trichlorobenzene
1,3-Dichlorobenzene
1-Methylnaphthalene
2,4-Dichlorophenol
2,4-Dinitrotoluene (2,4-DNT)
2-Chlorophenol
2-Nitroaniline
3-Nitroaniline
4-Chloro-3-methylphenol
4-Methylphenol
Acenaphthene
Anthracene
Benzo(a)pyrene
Benzo(k)fluoranthene
Bis(2-chloroethoxy) methane
Bis(2-ethylhexyl) phthalate
Chrysene
Diethyl phthalate
Di-n-octyl phthalate
Fluorene
Hexachlorocyclopentadiene
Isophorone
Nitrobenzene
N-Nitrosodiphenylamine
Pentachlorophenol
Pyrene

1,2-Dichlorobenzene
1,4-Dichlorobenzene
2,4,5-Trichlorophenol
2,4-Dimethylphenol
2,6-Dinitrotoluene (2,6-DNT)
2-Methylnaphthalene
2-Nitrophenol
4,6-Dinitro-2-methylphenol
4-Chloroaniline
4-Nitroaniline
Acenaphthylene
Benzidine
Benzo(b)fluoranthene
Benzoic acid
Bis(2-chloroethyl) ether
Butyl benzyl phthalate
Dibenz(a,h)anthracene
Dimethyl phthalate
Diphenylamine
Hexachlorobenzene
Hexachloroethane
m-Cresol (3-Methylphenol)
N-Nitrosodimethylamine
o-Cresol (2-Methylphenol)
Phenanthrene
Pyridine

1,2-Diphenylhydrazine
1,4-Dinitrobenzene
2,4,6-Trichlorophenol
2,4-Dinitrophenol
2-Chloronaphthalene
2-Methylphenol
3,3'-Dichlorobenzidine
4-Bromophenyl phenyl ether
4-Chlorophenyl phenyl ether
4-Nitrophenol
Aniline
Benzo(a)anthracene
Benzo(g,h,i)perylene
Benzyl alcohol
Bis(2-chloroisopropyl) ether
Carbazole
Dibenzofuran
Di-n-butyl phthalate
Fluoranthene
Hexachlorobutadiene
Indeno(1,2,3-cd) pyrene
Naphthalene
N-Nitrosodi-n-propylamine
p-Cresol (4-Methylphenol)
Phenol

8321A

2,4,5-T
2,4-DB
Dichlorprop
MCP

2,4,5-TP (Silvex)
Dalapon
Dinoseb

2,4-D
Dicamba
MCPA



UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899

September 20, 2007

Dr. Surendra N. Kumar
STAT Analysis Corporation
2242 W. Harrison
Chicago, IL 60612

NVLAP Lab Code: 101202-0

Dear Dr. Kumar:

I am pleased to inform you that your laboratory has met the requirements of ISO/IEC 17025:2005 for continuing accreditation for specific test methods in Bulk Asbestos Fiber Analysis (PLM). This accreditation is effective until June 30, 2008, provided that your organization continues to comply with accreditation requirements contained in the NVLAP Procedures.

Your Certificate of Accreditation is enclosed along with a statement of your Scope of Accreditation. You may reproduce these documents in their entirety and announce your organization's accreditation status using the NVLAP logo in business publications, the trade press, and other business-oriented literature. Accreditation does not relieve your organization from observing and complying with any applicable existing laws and/or regulations.

We are pleased to have you participate in NVLAP and look forward to your continued association with this program. If you have any questions concerning your NVLAP accreditation, please direct them to Thomas R. Davis, Sr. Program Manager, Laboratory Accreditation Program, National Institute of Standards and Technology, 100 Bureau Dr. Stop 2140, Gaithersburg, MD 20899-2140; (301) 975-4016.

Sincerely,

Sally S. Bruce, Chief
Laboratory Accreditation Program

Enclosure(s)





**National Voluntary
Laboratory Accreditation Program**



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

STAT Analysis Corporation

2242 W. Harrison

Chicago, IL 60612

Dr. Surendra N. Kumar

Phone: 312-733-0551 Fax: 312-733-2386

E-Mail: SKumar@STATAnalysis.com

URL: <http://www.STATAnalysis.com>

BULK ASBESTOS FIBER ANALYSIS (PLM)

NVLAP LAB CODE 101202-0

Scope Revised: 2007-09-20

NVLAP Code Designation / Description

18/A01	EPA-600/M4-82-020: Interim Method for the Determination of Asbestos in Bulk Insulation Samples
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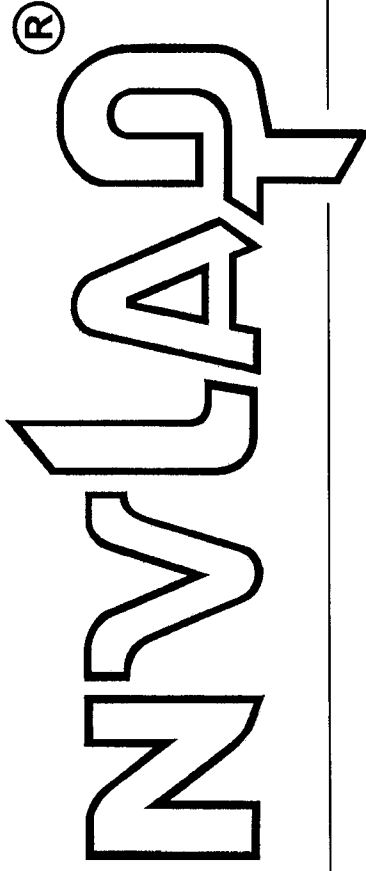
2007-07-01 through 2008-06-30

Effective dates

Sally D. Bruce

For the National Institute of Standards and Technology

United States Department of Commerce
National Institute of Standards and Technology



Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 101202-0

STAT Analysis Corporation
Chicago, IL

*is accredited by the National Voluntary Laboratory Accreditation Program for specific services,
listed on the Scope of Accreditation, for:*

BULK ASBESTOS FIBER ANALYSIS

*This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005.
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality
management system (refer to joint ISO-ILAC-IAF Communique dated 18 June 2005).*

2007-07-01 through 2008-06-30

Effective dates



Sally S. Bruce
For the National Institute of Standards and Technology



UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899

September 20, 2007

Dr. Surendra N. Kumar
STAT Analysis Corporation
2242 W. Harrison
Chicago, IL 60612

NVLAP Lab Code: 101202-0

Dear Dr. Kumar:

I am pleased to inform you that your laboratory has met the requirements of ISO/IEC 17025:2005 for continuing accreditation for specific test methods in Airborne Asbestos Fiber Analysis (TEM). This accreditation is effective until June 30, 2008, provided that your organization continues to comply with accreditation requirements contained in the NVLAP Procedures.

Your Certificate of Accreditation is enclosed along with a statement of your Scope of Accreditation. You may reproduce these documents in their entirety and announce your organization's accreditation status using the NVLAP logo in business publications, the trade press, and other business-oriented literature. Accreditation does not relieve your organization from observing and complying with any applicable existing laws and/or regulations.

We are pleased to have you participate in NVLAP and look forward to your continued association with this program. If you have any questions concerning your NVLAP accreditation, please direct them to Thomas R. Davis, Sr. Program Manager, Laboratory Accreditation Program, National Institute of Standards and Technology, 100 Bureau Dr. Stop 2140, Gaithersburg, MD 20899-2140; (301) 975-4016.

Sincerely,

Sally S. Bruce, Chief
Laboratory Accreditation Program

Enclosure(s)





**National Voluntary
Laboratory Accreditation Program**



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

STAT Analysis Corporation

2242 W. Harrison

Chicago, IL 60612

Dr. Surendra N. Kumar

Phone: 312-733-0551 Fax: 312-733-2386

E-Mail: SKumar@STATAnalysis.com

URL: <http://www.STATAnalysis.com>

AIRBORNE ASBESTOS FIBER ANALYSIS (TEM)

NVLAP LAB CODE 101202-0

Scope Revised: 2007-09-20

NVLAP Code Designation / Description

18/A02	U.S. EPA's "Interim Transmission Electron Microscopy Analytical Methods-Mandatory and Nonmandatory-and Mandatory Section to Determine Completion of Response Actions" as found in 40 CFR, Part 763, Subpart E, Appendix A.
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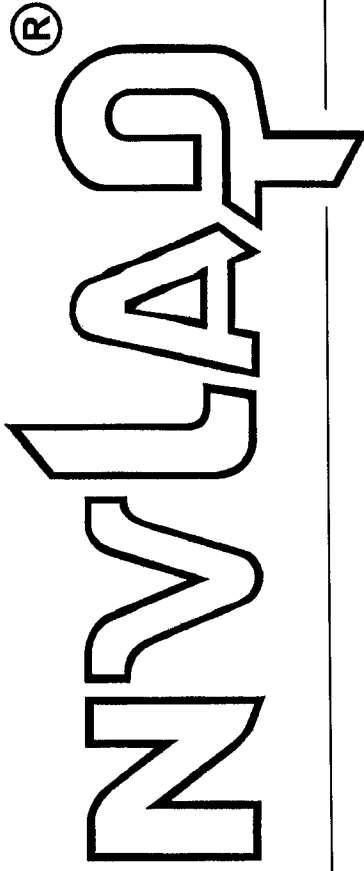
2007-07-01 through 2008-06-30

Effective dates

Sally S. Bruce

For the National Institute of Standards and Technology

United States Department of Commerce
National Institute of Standards and Technology



Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 101202-0

STAT Analysis Corporation
Chicago, IL

is accredited by the National Voluntary Laboratory Accreditation Program for specific services,
listed on the Scope of Accreditation, for:

AIRBORNE ASBESTOS FIBER ANALYSIS

*This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005.
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality
management system (refer to joint ISO-ILAC-IAF Communique dated 18 June 2005).*

2007-07-01 through 2008-06-30

Effective dates



Dolly S. Bruce
For the National Institute of Standards and Technology

APPENDIX C

STAT QA MANUAL AND SOPs (ON CDROM)

TABLE OF CONTENTS – ON THE CDROM STAT ANALYSIS STANDARD OPERATING PROCEDURES

3005 – METALS DIGEST WATER
3110 – METALS DIGEST SOIL
3500 – ORGANIC EXTRACTION
3610 – CYANIDE DISTILLATION (rev01)
4000 – VOC – 8260B
4020 – 8270C SVOC SOP (rev03)
4050 – PESTICIDES PCBs – 8081 and 8082
4080 – HERBICIDES
4210 – pH R01
4500 – PNA COMPOUNDS
4510 – ICP-MS-6020
4530 – MERCURY – 7470-7471
4550 – LEAD BY FLAA R04
4600 – HEXACHROME
4710 – CYANIDE ANALYSIS
5200 – PLM ASBESTOS BULK

APPENDIX D

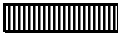
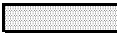

FIELD DATA SHEETS




TEST BORING LOG



Suite 320
 15 Spinning Wheel Drive
 Hinsdale, Illinois 60521
 312.207.1600

BORING / WELL NUMBER			
PROJECT NUMBER	PROJECT NAME	PROJECT LOCATION	
GEOLOGIST		DRILLING CONTRACTOR	
DRILLING EQUIPMENT / METHOD	SIZE / TYPE OF BIT	SAMPLING METHOD	START - FINISH DATE
WELL INSTALLED?	CASING MAT. / DIAMETER	SCREEN: TYPE MATERIAL LENGTH DIAMETER SLOT SIZE	
ELEVATION OF: GROUND SURFACE TOP OF WELL CASING TOP & BOTTOM OF SCREEN GW SURFACE DATE (FT. ABOVE M.S.L.)			

DEPTH	LAB SAMPLE	RECOVERY (%)	PID (ppm)	REMARKS	UNIFIED CLASS.	DESCRIPTION	GEO.	WELL CONST.
2								
4								
6								
8								
10								
12								
14								
16								
18								
20								

 CONCRETE
  SAND
  RISER

 FILL
  SILT
  SCREEN

 CLAY
  WATER DEPTH

CHAIN OF CUSTODY RECORD

N^o: _____ **Page :** _____ of _____

[illegible]

Page: of

Fax (2):			
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APPENDIX E

K-PLUS FIELD SOPs



ENVIRONMENTAL SERVICES

STANDARD OPERATING PROCEDURES

SOIL SAMPLING K-Plus SOP Number 1

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1.0 General Information

1.1 Purpose

This document describes general and specific procedures, methods and considerations to be used and observed when collecting soil samples for field screening or laboratory analysis.

1.2 Scope/Application

The procedures contained in this document are to be used by field personnel when collecting and handling soil samples in the field. On the occasion that SESD field personnel determine that any of the procedures described in this section are either inappropriate, inadequate or impractical and that another procedure must be used to obtain a soil sample, the variant procedure will be documented in the field log book and subsequent investigation report, along with a description of the circumstances requiring its use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and have been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the H: drive of the SESD local area network. The Field Quality Manager (FQM) is responsible for ensuring the most recent version of the procedure is placed on the H: drive and for maintaining records of review conducted prior to its issuance.

1.4 References

International Air Transport Authority (IATA). Dangerous Goods Regulations, Most Recent Version

SESD Operating Procedure for Sample and Evidence Management, SESDPROC-005, Most Recent Version

SESD Operating Procedure for Logbooks, SESDPROC-010, Most Recent Version

SESD Operating Procedure for Field Sampling Quality Control, SESDPROC-011, Most Recent Version

SESD Operating Procedure for Field X-Ray Fluorescence (XRF) Measurement, SESDPROC-107, Most Recent Version

SESD Operating Procedure for Equipment Inventory and Management, SESDPROC-108, Most Recent Version

SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205, Most Recent Version

SESD Operating Procedure for Packaging, Marking, Labeling and Shipping of Environmental and Waste Samples, SESDPROC-209, Most Recent Version

Title 49 Code of Federal Regulations, Pts. 171 to 179, Most Recent Version

United States Environmental Protection Agency (US EPA). 1981. "Final Regulation Package for Compliance with DOT Regulations in the Shipment of Environmental Laboratory Samples," Memo from David Weitzman, Work Group Chairman, Office of Occupational Health and Safety (PM-273), April 13, 1981.

US EPA. 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. Region 4 Science and Ecosystem Support Division (SESD), Athens, GA

US EPA. Analytical Support Branch Laboratory Operations and Quality Assurance Manual. Region 4 SESD, Athens, GA, Most Recent Version

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SESD, Athens, GA, Most Recent Version

1.5 General Precautions

1.5.1 Safety

Proper safety precautions must be observed when collecting soil samples. Refer to the SESD Safety, Health and Environmental Management Program (SHEMP) Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASP) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

1.5.2 Procedural Precautions

The following precautions should be considered when collecting soil samples.

- Special care must be taken not to contaminate samples. This includes storing samples in a secure location to preclude conditions which could alter the properties of the sample. Samples shall be custody sealed during long-term storage or shipment.
- Collected samples are in the custody of the sampler or sample custodian until the samples are relinquished to another party.

- If samples are transported by the sampler, they will remain under his/her custody or be secured until they are relinquished.
- Shipped samples shall conform to all U.S. Department of Transportation (DOT) rules of shipment found in Title 49 of the Code of Federal Regulations (49 CFR parts 171 to 179), and/or International Air Transportation Association (IATA) hazardous materials shipping requirements found in the current edition of IATA's Dangerous Goods Regulations.
- Documentation of field sampling is done in a bound logbook.
- Chain-of-custody documents shall be filled out and remain with the samples until custody is relinquished.
- All shipping documents, such as air bills, bills of lading, etc., shall be retained by the project leader in the project files.

2.0 Special Sampling Considerations

2.1 Soil Samples for Volatile Organic Compounds (VOC) Analysis

If samples are to be analyzed for volatile organic compounds, they should be collected in a manner that minimizes disturbance of the sample. For example, when sampling with a bucket auger, the sample for VOC analysis should be collected directly from the auger bucket (preferred) or from minimally disturbed material immediately after an auger bucket is emptied into the pan. The sample shall be containerized by filling an En Core® Sampler or other Method 5035 compatible container. ***Samples for VOC analysis are not homogenized.*** Preservatives may be required for some samples with certain variations of Method 5035. Consult the method or the principal analytical chemist to determine if preservatives are necessary.

2.2 Soil Sampling (Method 5035)

The following sampling protocol is recommended for site investigators assessing the extent of volatile organic compounds (VOC's) in soils at a project site. Because of the large number of options available, careful coordination between field and laboratory personnel is needed. The specific sampling containers and sampling tools required will depend upon the detection levels and intended data use. Once this information has been established, selection of the appropriate sampling procedure and preservation method best applicable to the investigation can be made.

2.2.1 Equipment

Soil for VOC analyses may be retrieved using any of the SESD soil sampling methods described in Sections 3 through 8 of this procedure. Once the soil has been obtained, the En Core® Sampler, syringes, stainless steel spatula, standard 2-oz. soil VOC container, or pre-prepared 40 ml vials may be used/required for sub-sampling. The specific sample containers and the sampling tools required will depend upon the data quality objectives established for the site or sampling investigation. The various sub-sampling methods are described below.

2.2.2 Sampling Methodology - Low Concentrations (<200 ug/kg)

When the total VOC concentration in the soil is expected to be less than 200µg/kg, the samples may be collected directly with the En Core® Sampler or syringe. If using the syringes, the sample must be placed in the sample container (40 ml pre-prepared vial) immediately to reduce volatilization losses. The 40 ml vials should contain 10 ml of organic-free water for an un-preserved sample or approximately 10 ml of organic-free water and a preservative. It is recommended that the 40 ml vials be prepared and weighed by the laboratory (commercial sources are available which supply preserved and tared vials). When sampling directly with the En Core® Sampler, the vial must be immediately capped and locked

A soil sample for VOC analysis may also be collected with conventional sampling equipment. A sample collected in this fashion must either be placed in the final sample container (En Core® Sampler or 40 ml pre-prepared vial) immediately or the sample may be immediately placed into an intermediate sample container with no head space. If an intermediate container (usually 2-oz. soil jar) is used, the sample must be transferred to the final sample container (En Core® Sampler or 40 ml pre-prepared vial) as soon as possible, not to exceed 30 minutes.

NOTE: After collection of the sample into either the En Core® Sampler or other container, the sample must immediately be stored in an ice chest and cooled.

Soil samples may be prepared for shipping and analysis as follows:

En Core® Sampler - the sample shall be capped, locked, and secured in a plastic bag.

Syringe - Add about 3.7 cc (approximately 5 grams) of sample material to 40-ml pre-prepared containers. Secure the containers in a plastic bag. Do not use a custody seal on the container; place the custody seal on the plastic bag. Note: When using the syringes, it is important that no air is allowed to become trapped behind the sample prior to extrusion, as this will adversely affect the sample.

Stainless Steel Laboratory Spatulas - Add between 4.5 and 5.5 grams (approximate) of sample material to 40 ml containers. Secure the containers in a plastic bag. Do not use a custody seal on the container; place the custody seal on the plastic bag.

2.2.3 Sampling Methodology - High Concentrations (>200 ug/kg)

Based upon the data quality objectives and the detection level requirements, this high level method may also be used. Specifically, the sample may be packed into a single 2-oz. glass container with a screw cap and septum seal. The sample container must be filled quickly and completely to eliminate head space. Soils/sediments containing high total VOC concentrations may also be collected as described in Section 2.2.2, Sampling Methodology - Low Concentrations, and preserved using 10 ml methanol.

2.2.4 Special Techniques and Considerations for Method 5035

Effervescence

If low concentration samples effervesce from contact with the acid preservative, then either a test for effervescence must be performed prior to sampling, or the investigators must be prepared to collect each sample both preserved or unpreserved as needed, or all samples must be collected unpreserved.

To check for effervescence, collect a test sample and add to a pre-preserved vial. If preservation (acidification) of the sample results in effervescence (rapid formation of bubbles) then preservation by acidification is not acceptable, and the sample must be collected un-preserved.

If effervescence occurs and only pre-preserved sample vials are available, the preservative solution may be placed into an appropriate hazardous waste container and the vials triple rinsed with organic free water. An appropriate amount of organic free water, equal to the amount of preservative solution, should be placed into the vial. The sample may then be collected as an un-preserved sample. Note that the amount of organic free water placed into the vials will have to be accurately measured.

Sample Size

While this method is an improvement over earlier ones, field investigators must be aware of an inherent limitation. Because of the extremely small sample size and the lack of sample mixing, sample representativeness for VOC's may be reduced compared to samples with larger volumes collected for other constituents. The sampling design and objectives of the investigation should take this into consideration.

Holding Times

Sample holding times are specified in the Analytical Support Branch *Laboratory Operations and Quality Assurance Manual* (ASBLOQAM), Most Recent Version. Field investigators should note that the holding time for an un-preserved VOC soil/sediment sample is 48 hours. Arrangements should be made to ship the soil/sediment VOC samples to the laboratory by overnight delivery the day they are collected so the laboratory may preserve and/or analyze the sample within 48 hours of collection.

Percent Moisture

Samplers must ensure that the laboratory has sufficient material to determine percent moisture in the VOC soil/sediment sample to correct the analytical results to dry weight. If other analyses requiring percent moisture determination are being performed upon the sample, these results may be used. If not, a separate sample (minimum of 2 oz.) for percent moisture determination will be required. The sample collected for Percent Moisture may also be used by the laboratory to check for preservative compatibility.

Safety

Methanol is a toxic and flammable liquid. Therefore, methanol must be handled with all required safety precautions related to toxic and flammable liquids. Inhalation of methanol

vapors must be avoided. Vials should be opened and closed quickly during the sample preservation procedure. Methanol must be handled in a ventilated area. Use protective gloves when handling the methanol vials. Store methanol away from sources of ignition such as extreme heat or open flames. The vials of methanol should be stored in a cooler with ice at all times.

Shipping

Methanol and sodium bisulfate are considered dangerous goods, therefore shipment of samples preserved with these materials by common carrier is regulated by the U.S. Department of Transportation and the International Air Transport Association (IATA). The rules of shipment found in Title 49 of the Code of Federal Regulations (49 CFR parts 171 to 179) and the current edition of the IATA Dangerous Goods Regulations must be followed when shipping methanol and sodium bisulfate. Consult the above documents or the carrier for additional information. Shipment of the quantities of methanol and sodium bisulfate used for sample preservation falls under the exemption for small quantities.

The summary table on the following page lists the options available for compliance with SW846 Method 5035. The advantages and disadvantages are noted for each option. SESD's goal is to minimize the use of hazardous material (methanol and sodium bisulfate) and minimize the generation of hazardous waste during sample collection.

2.3 Dressing Soil Surfaces

Any time a vertical or near vertical surface is sampled, such as achieved when shovels or similar devices are used for subsurface sampling, the surface should be dressed (scraped) to remove smeared soil. This is necessary to minimize the effects of contaminant migration interferences due to smearing of material from other levels.

Table 1: Method 5035 Summary

OPTION	PROCEDURE	ADVANTAGES	DISADVANTAGES
1	Collect 2 - 40 mL vials with ~5 grams of sample and 1 – 2 oz., glass w/septum lid for screening, % moisture and preservative compatibility	Screening conducted by lab	Presently a 48 hour holding time for unpreserved samples Sample containers must be tared
2	Collect 3 En Core® Samplers; and 1- 2 oz., glass w/septum lid for screening, % moisture and preservative compatibility	Lab conducts all preservation/preparation procedures	Presently a 48 hour holding time for preparation of samples
3	Collect 2 - 40 ml vials with 5 grams of sample and preserve w/methanol or sodium bisulfate and 1 - 2-oz., glass w/septum lid for screening, % moisture and preservative compatibility	High level VOC samples may be composited Longer holding time	Hazardous materials used in field Sample containers must be tared
4	Collect 1 - 2-oz., glass w/septum lid for analysis, % moisture and preservative compatibility	Lab conducts all preservation/preparation procedures	May have significant VOC loss

2.4 Special Precautions for Trace Contaminant Soil Sampling

- A clean pair of new, non-powdered, disposable gloves will be worn each time a different sample is collected and the gloves should be donned immediately prior to sampling. The gloves should not come in contact with the media being sampled and should be changed any time during sample collection when their cleanliness is compromised.

- Sample containers for samples suspected of containing high concentrations of contaminants shall be collected, handled and stored separately.
- All background samples shall be segregated from obvious high concentration or waste samples. Sample collection activities shall proceed progressively from the least suspected contaminated area to the most suspected contaminated area if sampling devices are to be reused. Samples of waste or highly contaminated media must not be placed in the same ice chest as environmental (i.e., containing low contaminant levels) or background samples.
- If possible, one member of the field sampling team should take all the notes and photographs, fill out tags, etc., while the other members collect the samples.
- Samplers must use new, verified certified-clean disposable or nondisposable equipment cleaned according to procedures contained in SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205), for collection of samples for trace metals or organic compound analyses.

2.5 Sample Homogenization

1. If sub-sampling of the primary sample is to be performed in the laboratory, transfer the entire primary sample directly into an appropriate, labeled sample container(s). Proceed to step 5.
2. If sub-sampling the primary sample in the field or compositing multiple primary samples in the field, place the sample into a glass or stainless steel homogenization container and mix thoroughly. Each aliquot of a composite sample should be of the same approximate volume.
3. All soil samples must be thoroughly mixed to ensure that the sample is as representative as possible of the sample media. ***Samples for VOC analysis are not homogenized.*** The most common method of mixing is referred to as quartering. The quartering procedure should be performed as follows:
 - The material in the sample pan should be divided into quarters and each quarter should be mixed individually.
 - Two quarters should then be mixed to form halves.
 - The two halves should be mixed to form a homogenous matrix.

This procedure should be repeated several times until the sample is adequately mixed. If round bowls are used for sample mixing, adequate mixing is achieved by stirring the material in a circular fashion, reversing direction, and occasionally turning the material over.

4. Place the sample into an appropriate, labeled container(s) by using the alternate shoveling method and secure the cap(s) tightly. The alternate shoveling method involves placing a spoonful of soil in each container in sequence and repeating until the containers are full or the sample volume has been exhausted. Threads on the container and lid should be cleaned to ensure a tight seal when closed.

5. Return any unused sample material back to the auger, drill or push hole from which the sample was collected.

2.6 Quality Control

If possible, a control sample should be collected from an area not affected by the possible contaminants of concern and submitted with the other samples. This control sample should be collected as close to the sampled area as possible and from the same soil type. Equipment blanks should be collected if equipment is field cleaned and re-used on-site or if necessary to document that low-level contaminants were not introduced by sampling tools. SESD Operating Procedure for Field Sampling Quality Control (SESDPROC- 011) contains other procedures that may be applicable to soil sampling investigations.

2.7 Records

Field notes, recorded in a bound field logbook, will be generated, as well as chain-of-custody documentation, as described in the SESD Operating Procedure for Logbooks (SESDPROC-010) and the SESD Operating Procedure for Sample and Evidence Management (SESDPROC-005).

3.0 Manual Soil Sampling Methods

3.1 General

These methods are used primarily to collect surface and shallow subsurface soil samples. Surface soils are generally classified as soils between the ground surface and 6 to 12 inches below ground surface. The most common interval is 0 to 6 inches, however the data quality objectives of the investigation may dictate another interval, such as 0 to 3 inches for risk assessment purposes. The shallow subsurface interval may be considered to extend from approximately 12-inches below ground surface to a site-specific depth at which sample collection using manual collection methods becomes impractical.

3.2 Spoons

Stainless steel spoons may be used for surface soil sampling to depths of approximately 6-inches below ground surface where conditions are generally soft and non-indurated and there is no problematic vegetative layer to penetrate.

3.2.1 Special Considerations When Using Spoons

- When using stainless steel spoons, consideration must be given to the procedure used to collect the volatile organic compound sample. If the soil being sampled is cohesive and holds its in situ texture in the spoon, the En Core® Sampler or syringe used to collect the sub-sample for Method 5035 should be plugged directly from the spoon. If, however, the soil is not cohesive and crumbles when removed from the ground surface for sampling, consideration should be given to plugging the sample for Method 5035 directly from the ground surface at a depth appropriate for the investigation Data Quality Objectives.
- When compositing, make sure that each composite location (aliquot) consist of equal volumes, i.e., same number of equal spoonfuls.
- If a thick, matted root zone is present at or near the surface, it should be removed before the sample is collected

3.3 Hand Augers

Hand augers may be used to advance boreholes and collect soil samples in the surface and shallow subsurface intervals. Typically, 4-inch stainless steel auger buckets with cutting heads are used. The bucket is advanced by simultaneously pushing and turning using an attached handle.

3.3.1 Surface Soil Sampling

When conducting surface soil sampling with hand augers, the auger buckets may be used with a handle alone or with a handle and extensions. The bucket is advanced to the appropriate depth and the contents are transferred to the homogenization container for

processing. Observe precautions for volatile organic compound sample collection found in Section 2.2.4, Special Techniques and Considerations for Method 5035.

3.3.2 Subsurface Soil Sampling

Hand augers are the most common equipment used to collect shallow subsurface soil samples. Auger holes are advanced one bucket at a time until the sample depth is achieved. When the sample depth is reached, the bucket used to advance the hole is removed and a clean bucket is attached. The clean auger bucket is then placed in the hole and filled with soil to make up the sample and removed. The practical depth of investigation using a hand auger depends upon the soil properties and depth of investigation. In sand, augering is usually easily performed, but the depth of collection is limited to the depth at which the sand begins to flow or collapse. Hand augers may also be of limited use in tight clays or cemented sands. In these soil types, the greater the depth attempted, the more difficult it is to recover a sample due to increased friction and torqueing of the hand auger extensions. At some point these problems become so severe that power equipment must be used.

3.3.3 Special Considerations for Soil Sampling with the Hand Auger

- Because of the tendency for the auger bucket to scrape material from the sides of the auger hole while being extracted, the top several inches of soil in the auger bucket should be discarded prior to placing the bucket contents in the homogenization container for processing.
- Observe precautions for volatile organic compound sample collection found in Section 2.2.4, Special Techniques and Considerations for Method 5035. Collect the VOC sample directly from the auger bucket, if possible.
- Power augers, such as the Little Beaver®, and drill rigs may be used to advance boreholes to depths for subsurface soil sampling with the hand auger. They may not be used for sample collection. When power augers are used to advance a borehole to depth for sampling, care must be taken that exhaust fumes, gasoline and/or oil do not contaminate the borehole or area in the immediate vicinity of sampling.
- When a new borehole is advanced, the entire hand auger assembly must be replaced with a properly decontaminated hand auger assembly.

4.0 Direct Push Soil Sampling Methods

4.1 General

These methods are used primarily to collect shallow and deep subsurface soil samples. Three methods are available for use with either the Geoprobe® or the drill rig adapted with a hydraulic hammer. All methods involve the collection and retrieval of the soil sample within a thin-walled liner. The following sections describe each of the specific sampling methods that can be accomplished using direct push techniques, along with details specific to each method.

4.2 Large Bore® Soil Sampler

The Large Bore® (LB) sampler is a solid barrel direct push sampler equipped with a piston-rod point assembly used primarily for collection of depth-discrete subsurface soil samples. The sample barrel is approximately 30-inches (762 mm) long and has a 1.5- inch (38 mm) outside diameter. The LB® sampler is capable of recovering a discrete sample core 22 inches x 1.0 inch (559 mm x 25 mm) contained inside a removable liner. The resultant sample volume is a maximum of 283 ml.

After the LB® sample barrel is equipped with the cutting shoe and liner, the piston-rod point assembly is inserted, along with the drive head and piston stop assembly. The assembled sampler is driven to the desired sampling depth, at which time the piston stop pin is removed, freeing the push point. The LB® sampler is then pushed into the soil a distance equal to the length of the LB® sample barrel. The probe rod string, with the LB® sampler attached, is then removed from the subsurface. After retrieval, the LB® sampler is then removed from the probe rod string. The drive head is then removed to allow removal of the liner and soil sample.

4.3 Macro-Core® Soil Sampler

The Macro-Core® (MC) sampler is a solid barrel direct push sampler equipped with a piston-rod point assembly used primarily for collection of either continuous or depth-discrete subsurface soil samples. Although other lengths are available, the standard MC® sampler has an assembled length of approximately 52 inches (1321 mm) with an outside diameter of 2.2 inches (56 mm). The MC® sampler is capable of recovering a discrete sample core 45 inches x 1.5 inches (1143 mm x 38 mm) contained inside a removable liner. The resultant sample volume is a maximum of 1300 ml. The MC® sampler may be used in either an open-tube or closed-point configuration. Samples collected for chemical analyses must be collected with the closed-point configuration. If used for collection of soil for stratigraphic descriptions, the open-tubed configuration is acceptable.

4.4 Dual Tube Soil Sampling System

The Dual Tube 21 soil sampling system is a direct push system for collecting continuous core samples of unconsolidated materials from within a sealed outer casing of 2.125-inch (54 mm) OD probe rod. The samples are collected within a liner that is threaded onto the leading end of a string of 1.0-inch diameter probe rod. Collected samples have a volume of up to 800 ml in the form of a 1.125-inch x 48-inch (29 mm x 1219 mm) core. Use of this method allows for collection of continuous core inside a cased hole, minimizing or preventing cross-contamination between different intervals during sample collection. The outer casing is advanced, one core length at a time, with only the inner probe rod and core being removed and replaced between samples. If the sampling zone of interest begins at some depth below ground surface, a solid drive tip must be used to drive the dual tube assembly and core to its initial sample depth.

4.5 Special Considerations When Using Direct Push Sampling Methods

- *Liner Use and Material Selection* – Due to the mode of operation, the samples must be collected with a liner. Liners are available in the following materials: stainless steel, brass, cellulose acetate butyrate (CAB), PETG, polyvinyl chloride (PVC) and Teflon®. For the majority of environmental investigations conducted by EIB, either CAB or Teflon® liners are used. If samples are collected for organic compound analyses, Teflon® liners are required. CAB or PVC liners may be used if metals or other inorganic constituents are the object of the investigation.
- *Sample Orientation* – When the liners and associated sample are removed from the sample tubes, it is important to maintain the proper orientation of the sample. This is particularly important when multiple sample depths are collected from the same push. It is also important to maintain proper orientation to define precisely the depth at which an aliquot was collected. Maintaining proper orientation is typically accomplished using vinyl end caps. Convention is to place red caps on the top of the liner and black caps on the bottom to maintain proper sample orientation. Orientation can also be indicated by marking on the exterior of the liner with a permanent marker.
- *Core Catchers* – Occasionally the material being sampled lacks cohesiveness and is subject to crumbling and falling out of the sample liner. In cases such as these, the use of core catchers on the leading end of the sampler may help retain the sample until it is retrieved to the surface. Materials of construction for core catchers must be consistent with the type of liner used, i.e., if stainless steel liners are required, stainless steel core catchers must be used.
- *VOC Sample Collection* - Observe precautions for volatile organic compound sample collection found in Section 2.2.4, Special Techniques and Considerations for Method 5035.

5.0 Split Spoon/Drill Rig Methods

5.1 General

Split spoon sampling methods are used primarily to collect shallow and deep subsurface soil samples. All split spoon samplers, regardless of size, are basically split cylindrical barrels that are threaded on each end. The leading end is held together with a beveled threaded collar that functions as a cutting shoe. The other end is held together with a threaded collar that serves as the sub used to attach the spoon to the string of drill rod. Two basic methods are available for use, including the smaller diameter standard split spoon, driven with the drill rig safety hammer, and the larger diameter continuous split spoon, advanced inside and slightly ahead of the lead auger during hollow stem auger drilling. The following sections describe each of the specific sampling methods, along with details specific to each method.

5.2 Standard Split Spoon

A drill rig is used to advance a borehole to the target depth. The drill string is then removed and a standard split spoon is attached to a string of drill rod. Split spoons used for soil sampling must be constructed of stainless steel and are typically 2.0-inches OD (1.5-inches ID) and 18-inches to 24-inches in length. Other diameters and lengths are common and may be used if constructed of the proper material. After the spoon is attached to the string of drill rod it is lowered into the borehole. The drill rig safety hammer is then used to drive the split spoon into the soil at the bottom of the borehole. After the split spoon has been driven into the soil, filling the spoon, it is retrieved to the surface, where it is removed from the drill rod string and opened for sample acquisition.

5.3 Continuous Split Spoon

The continuous split spoon is a large diameter split spoon that is advanced into the soil column inside a hollow stem auger. Continuous split spoons are typically 3-inches to 5-inches in diameter and either 5-feet or 10-feet in length, although the 5-foot long samplers are most common. After the auger string has been advanced into the soil column a distance equal to the length of the sampler being used it is returned to the surface. The sampler is removed from inside the hollow stem auger and the threaded collars are removed. The split spoon is then opened for sampling.

5.4 Special Considerations When Using Split Spoon Sampling Methods

- Always discard the top several inches of material in the spoon before removing any portion for sampling. This material normally consists of borehole wall material that has sloughed off of the borehole wall after removal of the drill string prior to and during inserting the split spoon.

- Observe precautions for volatile organic compound sample collection found in Section 2.2.4, Special Techniques and Considerations for Method 5035.

6.0 Shelby Tube/Thin-Walled Sampling Methods

6.1 General

Shelby tubes, also referred to generically as thin-walled push tubes or Acker thin-walled samplers, are used to collect subsurface soil samples in cohesive soils and clays during drilling activities. In addition to samples for chemical analyses, Shelby tubes are also used to collect relatively undisturbed soil samples for geotechnical analyses, such as hydraulic conductivity and permeability, to support hydrogeologic characterizations at hazardous waste and other sites.

6.2 Shelby Tube Sampling Method

A typical Shelby tube is 30-inches in length and has a 3.0-inch OD (2.875 ID) and may be constructed of steel, stainless steel, galvanized steel, or brass. They also typically are attached to push heads that are constructed with a ball-check to aid in holding the contained sample during retrieval. If used for collecting samples for chemical analyses, it must be constructed of stainless steel. If used for collecting samples for standard geotechnical parameters, any material is acceptable.

To collect a sample, the tube is attached to a string of drill rod and is lowered into the borehole, where the sampler is then pressed into the undisturbed clay or silts by hydraulic force. After retrieval to the surface, the tube containing the sample is then removed from the sampler head. If samples for chemical analyses are needed, the soil contained inside the tube is then removed for sample acquisition. If the sample is collected for geotechnical parameters, the tube is typically capped, maintaining the sample in its relatively undisturbed state, and shipped to the appropriate geotechnical laboratory.

6.3 Special Considerations When Using Split Spoon Sampling Methods

Observe precautions for volatile organic compound sample collection found in Section 2.2.4, Special Techniques and Considerations for Method 5035.

7.0 Backhoe Sampling Method

7.1 General

Backhoes may be used in the collection of surface and shallow subsurface soil samples. The trenches created by excavation with a backhoe offer the capability of collecting samples from very specific intervals and allow visual correlation with vertically and horizontally adjacent material. If possible, the sample should be collected without entering the trench. Samples may be obtained from the trench wall or they may be obtained directly from the bucket at the surface. The following sections describe various techniques for safely collecting representative soil samples with the aid of a backhoe.

7.2 Scoop and Bracket Method

If a sample interval is targeted from the surface, it can be sampled using a stainless steel scoop and bracket. First a scoop and bracket are affixed to a length of conduit and is lowered into the backhoe pit. The first step is to take the scoop and scrape away the soil comprising the surface of the excavated wall. This material likely represents soil that has been smeared by the backhoe bucket from adjacent material. After the smeared material has been scraped off, the original stainless steel scoop is removed and a clean stainless steel scoop is placed on the bracket. The clean scoop can then be used to remove sufficient volume of soil from the excavation wall to make up the required sample volume.

7.3 Direct-From-Bucket Method

It is also possible to collect soil samples directly from the backhoe bucket at the surface. Some precision with respect to actual depth or location may be lost with this method but if the soil to be sampled is uniquely distinguishable from the adjacent or nearby soils, it may be possible to characterize the material as to location and depth. In order to ensure representativeness, it is also advisable to dress the surface to be sampled by scraping off any smeared material that may cross-contaminate the sample.

7.4 Special Considerations When Sampling with a Backhoe

- Do not physically enter backhoe excavations to collect a sample. Use procedure 7.2, Scoop and Bracket Method, or procedure 7.3, Direct-From-Bucket Method to obtain soil for sampling.
- Smearing is an important issue when sampling with a backhoe. Measures must be taken, such as dressing the surfaces to be sampled (see Section 2.3), to mitigate problems with smearing.
- Paint, grease and rust must be removed and the bucket decontaminated prior to sample collection.
- Observe precautions for volatile organic compound sample collection found in Section 2.2.4, Special Techniques and Considerations for Method 5035.



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Contents

1.0 General Information

1.1 Purpose

This document describes general and specific procedures, methods and considerations to be used and observed when cleaning and decontaminating sampling equipment during the course of field investigations.

1.2 Scope/Application

The procedures contained in this document are to be followed when field cleaning sampling equipment, for both re-use in the field, as well as used equipment being returned to the Field Equipment Center (FEC). On the occasion that SESD field investigators determine that any of the procedures described in this section are either inappropriate, inadequate or impractical and that other procedures must be used to clean or decontaminate sampling equipment at a particular site, the variant procedure will be documented in the field log book, along with a description of the circumstances requiring its use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and have been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the H: drive of the SESD local area network. The Field Quality Manager (FQM) is responsible for ensuring the most recent version of the procedure is placed on the H: drive and for maintaining records of review conducted prior to its issuance.

1.4 Definitions

Decontamination: The process of cleaning dirty sampling equipment to the degree to which it can be re-used, with appropriate QA/QC, in the field.

Field Cleaning: The process of cleaning dirty sampling equipment such that it can be returned to the FEC in a condition that will minimize the risk of transfer of contaminants from a site.

De-ionized water: Tap water that has been treated by passing through a standard deionizing resin column. At a minimum, the finished water should contain no detectable heavy metals or other inorganic compounds (i.e., at or above analytical detection limits) as defined by a standard inductively coupled Argon Plasma Spectrophotometer (ICP) (or equivalent) scan. De-ionized water obtained by other methods is acceptable, as long as it meets the above analytical criteria. Organic-free water may be substituted for de-ionized water.

Organic-free water: Tap water that has been treated with activated carbon and de-ionizing units. At a minimum, the finished water must meet the analytical criteria of de-ionized water and it should contain no detectable pesticides, herbicides, or extractable organic compounds, and no volatile organic compounds above minimum detectable levels as determined by the Region 4 laboratory for a given set of analyses. Organic-free water obtained by other methods is acceptable, as long as it meets the above analytical criteria.

Soap: A standard brand of phosphate-free laboratory detergent, such as Luminox®.

Tap water: Water from any potable water supply. De-ionized water or organic-free water may be substituted for tap water.

Drilling Equipment: All power equipment used to collect surface and sub-surface soil samples or install wells. For purposes of this procedure, direct push is also included in this definition.

1.5 References

SESD Operating Procedure for Management of Investigation Derived Waste, SESDPROC-202, Most Recent Version

SESD Operating Procedure for Equipment Cleaning and Decontamination at the FEC, SESDPROC-206, Most Recent Version

United States Environmental Protection Agency (US EPA). 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. Region 4 Science and Ecosystem Support Division (SESD), Athens, GA

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SESD, Athens, GA, Most Recent Version

1.6 General Precautions

1.6.1 Safety

Proper safety precautions must be observed when field cleaning or decontaminating dirty sampling equipment. Refer to the SESD Safety, Health and Environmental Management Program (SHEMP) Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASPs) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate. At a minimum, the following precautions should be taken in the field during these cleaning operations:

- When conducting field cleaning or decontamination using laboratory detergent, safety glasses with splash shields or goggles, and latex gloves will be worn.
- No eating, smoking, drinking, chewing, or any hand to mouth contact should be permitted during cleaning operations.

1.6.2 Procedural Precautions

Prior to mobilization to a site, the expected types of contamination should be evaluated to determine if the field cleaning and decontamination activities will generate rinsates and other waste waters that might be considered RCRA hazardous waste or may require special handling.

2.0 Introduction to Field Equipment Cleaning and Decontamination

2.1 General

The procedures outlined in this document are intended for use by field investigators for cleaning and decontaminating sampling and other equipment in the field. These procedures should be followed in order that equipment is returned to the FEC in a condition that will minimize the risk of transfer of contaminants from a site.

Sampling and field equipment cleaned in accordance with these procedures must meet the minimum requirements for the Data Quality Objectives (DQOs) of the study or investigation. Site-specific alterations to these procedures should be documented in the study plan. Deviations from these procedures should be documented in the field records.

Cleaning procedures for use at the Field Equipment Center (FEC) are found in SESD Operating Procedure for Equipment Cleaning and Decontamination at the FEC (SESDPROC-206).

2.2 Handling and Containers for Cleaning Solutions

Improperly handled cleaning solutions may easily become contaminated. Storage and application containers must be constructed of the proper materials to ensure their integrity. Following are acceptable materials used for containing the specified cleaning solutions:

- Soap must be kept in clean plastic, metal, or glass containers until used. It should be poured directly from the container during use.
- Tap water may be kept in tanks, hand pressure sprayers, squeeze bottles, or applied directly from a hose.
- De-ionized water must be stored in clean, glass or plastic containers that can be closed prior to use. It can be applied from plastic squeeze bottles.
- Organic-free water must be stored in clean glass or Teflon® containers prior to use. It may be applied using Teflon® squeeze bottles, or with the portable system.

2.3 Disposal of Cleaning Solutions

Procedures for the safe handling and disposition of investigation derived waste (IDW); including used wash water and rinse water are in SESD Operating Procedure for Management of Investigation Derived Waste (SESDPROC-202).

2.4 Sample Collection Equipment Contaminated with Concentrated Materials

Equipment used to collect samples of concentrated materials from investigation sites must be field cleaned before returning from the study. At a minimum, this should consist of washing with soap and rinsing with tap water. When the above procedure cannot be followed, the following options are acceptable:

1. Leave with facility for proper disposal;
2. If possible, containerize, seal and secure the equipment and leave on-site for later disposal;
3. Containerize, bag or seal the equipment so that no odor is detected and return to the SESD.

It is the project leader's responsibility to evaluate the nature of the sampled material and determine the most appropriate cleaning procedures for the equipment used to sample that material.

2.5 Sample Collection Equipment Contaminated with Environmental Media

Equipment used to collect samples of environmental media from investigation sites should be field cleaned before returning from the study. Based on the condition of the sampling equipment, one or more of the following options must be used for field cleaning:

1. Wipe the equipment clean;
2. Water-rinse the equipment;
3. Wash the equipment in detergent and water followed by a tap water rinse.
4. For grossly contaminated equipment, the procedures set forth in Section 2.4 must be followed.

Under extenuating circumstances such as facility limitations, regulatory limitations, or during residential sampling investigations where field cleaning operations are not feasible, equipment can be containerized, bagged or sealed so that no odor is detected and returned to the FEC without being field cleaned. If possible, FEC personnel should be notified that equipment will be returned without being field cleaned. It is the project leader's responsibility to evaluate the nature of the sampled material and determine the most appropriate cleaning procedures for the equipment used to sample that material.

2.6 Handling of Decontaminated Equipment

After decontamination, equipment should be handled only by personnel wearing clean gloves to prevent re-contamination. In addition, the equipment should be moved away (preferably upwind) from the decontamination area to prevent re-contamination. If the equipment is not to be immediately re-used it should be covered with plastic sheeting or wrapped in aluminum foil to prevent re-contamination. The area where the equipment is kept prior to re-use must be free of contaminants.

3.0 Field Equipment Decontamination Procedures

3.1 General

Sufficient equipment should be transported to the field so that an entire study can be conducted without the need for decontamination. When equipment must be decontaminated in the field, the following procedures are to be utilized.

3.2 Specifications for Decontamination Pads

Decontamination pads constructed for field cleaning of sampling and drilling equipment should meet the following minimum specifications:

- The pad should be constructed in an area known or believed to be free of surface contamination.
- The pad should not leak.
- If possible, the pad should be constructed on a level, paved surface and should facilitate the removal of wastewater. This may be accomplished by either constructing the pad with one corner lower than the rest, or by creating a sump or pit in one corner or along one side. Any sump or pit should also be lined.
- Sawhorses or racks constructed to hold equipment while being cleaned should be high enough above ground to prevent equipment from being splashed.
- Water should be removed from the decontamination pad frequently.
- A temporary pad should be lined with a water impermeable material with no seams within the pad. This material should be either easily replaced (disposable) or repairable.

At the completion of site activities, the decontamination pad should be deactivated. The pit or sump should be backfilled with the appropriate material designated by the site project leader, but only after all waste/rinse water has been pumped into containers for disposal. See SESD Operating Procedure for Management of Investigation Derived Waste (SESDPROC-202) for proper handling and disposal of these materials. If the decontamination pad has leaked excessively, soil sampling may be required.

3.3 "Classical Parameter" Sampling Equipment

"Classical Parameters" are analyses such as oxygen demand, nutrients, certain inorganics, sulfide, flow measurements, etc. For routine operations involving classical parameter analyses, water quality sampling equipment such as Kemmerers, buckets, dissolved oxygen dunkers, dredges, etc., may be cleaned with the sample water or tap water between sampling locations as appropriate.

Flow measuring equipment such as weirs, staff gages, velocity meters, and other stream gauging equipment may be cleaned with tap water between measuring locations, if necessary.

Note: The procedures described in Section 3.3 are not to be used for cleaning field equipment to be used for the collection of samples undergoing trace organic or inorganic constituent analyses.

3.4 Sampling Equipment used for the Collection of Trace Organic and Inorganic Compounds

For samples undergoing trace organic or inorganic constituent analyses, the following procedures are to be used for all sampling equipment or components of equipment that come in contact with the sample:

1. Clean with tap water and Luminox® soap using a brush, if necessary, to remove particulate matter and surface films. Equipment may be steam cleaned (Luminox® soap and high pressure hot water) as an alternative to brushing. Sampling equipment that is steam cleaned should be placed on racks or saw horses at least two feet above the floor of the decontamination pad. PVC or plastic items should not be steam cleaned.
2. Rinse thoroughly with tap water.
3. Rinse thoroughly with organic-free water and place on a clean foil-wrapped surface to air-dry.
4. All equipment must be wrapped with foil. If the equipment is to be stored overnight before it is wrapped in foil, it should be covered and secured with clean, unused plastic sheeting.

3.5 Well Sounders or Tapes

The following procedures are recommended for decontaminating well sounders (water level indicators) and tapes:

1. Wash with soap and tap water.
2. Rinse with tap water.
3. Rinse with de-ionized water.

3.6 Redi-Flo2® Pump

The Redi-Flo2® pump should be decontaminated prior to use and between each monitoring well. The following procedure is required:

CAUTION - Make sure the pump is not plugged in.

1. Using a brush, scrub the exterior of the pump, electrical cord and garden hose with soap and tap water. Do not wet the electrical plug.
2. Rinse with tap water.
3. Rinse with de-ionized water.
4. Place the equipment in a clean plastic bag.

To clean the Redi-Flo2® ball check valve:

1. Remove the ball check valve from the pump head. Check for wear and/or corrosion, and replace as needed.
2. Using a brush, scrub all components with soap and tap water.
3. Rinse with de-ionized water.
4. Replace the ball check valve to the Redi-Flo27 pump head.

3.7 Downhole Drilling Equipment

These procedures are to be used for drilling activities involving the collection of soil samples for trace organic and inorganic constituent analyses and for the construction of monitoring wells to be used for the collection of groundwater samples for trace organic and inorganic constituent analyses.

3.7.1 Introduction

Cleaning and decontamination of all equipment should occur at a designated area (decontamination pad) on the site. The decontamination pad should meet the specifications of Section 3.2 of this procedure.

Tap water brought on the site for drilling and cleaning purposes should be contained in a pre-cleaned tank.

A steam cleaner and/or high pressure hot water washer capable of generating a pressure of at least 2500 PSI and producing hot water and/or steam (200° F plus), with a soap compartment, should be obtained.

3.7.2 Preliminary Cleaning and Inspection

Drilling equipment should be clean of any contaminants that may have been transported from off-site to minimize the potential for cross-contamination. The drilling equipment should not serve as a source of contaminants. Associated drilling and decontamination equipment, well construction materials, and equipment handling procedures should meet these minimum specified criteria:

- All downhole augering, drilling, and sampling equipment should be sandblasted before use if painted, and/or there is a buildup of rust, hard or caked matter, etc., that cannot be removed by steam cleaning (soap and high pressure hot water), or wire brushing. Sandblasting should be performed prior to arrival on site, or well away from the decontamination pad and areas to be sampled.
- Any portion of the drilling equipment that is over the borehole (kelly bar or mast, backhoe buckets, drilling platform, hoist or chain pulldowns, spindles, cathead, etc.) should be steam cleaned (soap and high pressure hot water) and wire brushed (as needed) to remove all rust, soil, and other material which may have come from other sites before being brought on site.

- Printing and/or writing on well casing, tremie tubing, etc., should be removed before use. Emery cloth or sand paper can be used to remove the printing and/or writing. Most well material suppliers can provide materials without the printing and/or writing if specified when ordered. Items that cannot be cleaned are not acceptable and should be discarded.
- Equipment associated with the drilling and sampling activities should be inspected to insure that all oils, greases, hydraulic fluids, etc., have been removed, and all seals and gaskets are intact with no fluid leaks.

3.7.3 Drill Rig Field Cleaning Procedure

Any portion of the drill rig, backhoe, etc., that is over the borehole (kelly bar or mast, backhoe buckets, drilling platform, hoist or chain pulldowns, spindles, cathead, etc.) should be steam cleaned (soap and high pressure hot water) between boreholes.

3.7.4 Field Decontamination Procedure for Drilling Equipment

The following is the standard procedure for field cleaning augers, drill stems, rods, tools, and associated equipment. This procedure does not apply to well casings, well screens, or split-spoon samplers used to obtain samples for chemical analyses, which should be decontaminated as outlined in Section 3.4 of this procedure.

1. Wash with tap water and soap, using a brush if necessary, to remove particulate matter and surface films. Steam cleaning (high pressure hot water with soap) may be necessary to remove matter that is difficult to remove with the brush. Drilling equipment that is steam cleaned should be placed on racks or saw horses at least two feet above the floor of the decontamination pad. Hollow-stem augers, drill rods, etc., that are hollow or have holes that transmit water or drilling fluids, should be cleaned on the inside with vigorous brushing.
2. Rinse thoroughly with tap water.
3. Remove from the decontamination pad and cover with clean, unused plastic. If stored overnight, the plastic should be secured to ensure that it stays in place.



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Contents

1.0 General Information

1.1 Purpose

This document describes general and specific procedures and considerations to be used and observed when managing investigation derived waste (IDW) generated during the course of hazardous waste site investigations.

1.2 Scope/Application

The procedures and management options for the different categories of IDW described in this document are to be used by SESD field personnel to manage IDW generated during site investigations. On the occasion that SESD field personnel determine that any of the procedures described in this section are inappropriate, inadequate or impractical and that another procedure must be used to manage IDW generated at a particular site, the variant procedure will be documented in the field log book, along with a description of the circumstances requiring its use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and have been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the H: drive of the SESD local area network. The Field Quality Manager (FQM) is responsible for ensuring the most recent version of the procedure is placed on the H: drive and for maintaining records of review conducted prior to its issuance.

1.4 References

SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205, Most Recent Version

United States Environmental Protection Agency (US EPA). 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. Region 4 Science and Ecosystem Support Division (SESD), Athens, GA

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SESD, Athens, GA, Most Recent Version

1.5 General Precautions

1.5.1 Safety



Proper safety precautions must be observed when managing IDW. Refer to the SESD Safety, Health and Environmental Management Program (SHEMP) Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASP) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

1.5.2 Procedural Precautions

The following precautions should be considered when managing IDW:

- Due to time limitations and restrictions posed by RCRA regulations on storage of hazardous waste, accumulation start dates should be identified on all drums, buckets or other containers used to hold IDW so that it can be managed in a timely manner.
- During generation of both non-hazardous and hazardous IDW, keep hazardous IDW segregated from non-hazardous IDW to minimize the volume of hazardous IDW that must be properly managed.

2.0 Types of Investigation Derived Waste

Materials which may become IDW include, but are not limited to:

- Personnel protective equipment (PPE) - This includes disposable coveralls, gloves, booties, respirator canisters, splash suits, etc.
- Disposable equipment and items - This includes plastic ground and equipment covers, aluminum foil, conduit pipe, composite liquid waste samplers (COLIWASAs), Teflon® tubing, broken or unused sample containers, sample container boxes, tape, etc.
- Soil cuttings from drilling or hand augering.
- Drilling mud or water used for mud or water rotary drilling.
- Groundwater obtained through well development or well purging.
- Cleaning fluids such as spent solvents and wash water.
- Packing and shipping materials.

Table 1, found at the end of this procedure, lists the types of IDW commonly generated during field investigations and the current disposal practices for these materials.

For the purpose of determining the ultimate disposition of IDW, it is typically distinguished as being either hazardous or non-hazardous. This determination is based on either clear regulatory guidance or by subsequent analysis. This determination and subsequent management is the responsibility of the program site manager.

3.0 Management of Non-Hazardous IDW

Disposal of non-hazardous IDW should be addressed in the study plan or QAPP for the investigation. To reduce the volume of any IDW transported back to the Field Equipment Center (FEC), it may be necessary to compact the waste into a reusable container, such as a 55-gallon drum.

If the waste is from an active facility, permission should be sought from the operator of the facility to place the non-hazardous PPE, disposable equipment, and/or paper/cardboard into the facilities' dumpsters. If necessary, these materials may be placed into municipal dumpsters, with the permission of the owner. These materials may also be taken to a nearby permitted landfill. On larger studies, waste hauling services may be obtained and a dumpster located at the study site.

Disposal of non-hazardous IDW such as drill cuttings, purge or development water, decontamination wash water, drilling mud, etc., should be specified in the approved study plan or QAPP. It is recommended that these materials be placed into a unit with an environmental permit, such as a landfill or sanitary sewer. These materials must not be placed into dumpsters. If the facility at which the study is being conducted is active, permission should be sought to place these types of IDW into the facilities treatment system. It may be feasible to spread drill cuttings around the borehole, or, if the well is temporary, to place the cuttings back into the borehole. Non-hazardous monitoring well purge or development water may also be poured onto the ground down gradient of the monitoring well when site conditions permit. Purge water from private potable wells which are in service may be discharged directly onto the ground surface.

The minimum requirements for this subsection are:

- Non-hazardous liquid and soil/sediment IDW may be placed on the ground or returned to the source if doing so does not endanger human health or the environment or violate federal or state regulations. Under no circumstances, however, should monitoring well purge water be placed back into the well from which it came.
- Soap and water decontamination fluids and rinsates of such cannot be placed in any water bodies and must be collected and returned to the FEC for disposition.
- The collection, handling and proposed disposal method must be specified in the approved study plan or QAPP.

4.0 Management of Hazardous IDW

Disposal of hazardous or suspected hazardous IDW must be specified in the approved study plan or QAPP for the study or investigation. Hazardous IDW must be disposed as specified in USEPA regulations. If appropriate, these wastes may be placed back in an active facility waste treatment system. These wastes may also be disposed in the source area from which they originated if doing so does not endanger human health or the environment.

If on-site disposal is not feasible, and if the wastes are suspected to be hazardous, appropriate tests must be conducted to make that determination. If they are determined to be hazardous wastes, they must be properly contained and labeled. They may be stored on the site for a maximum of 90 days before they must be manifested and shipped to a permitted treatment or disposal facility. Generation of hazardous IDW must be anticipated, if possible, to allow arrangements for proper containerization, labeling, transportation and disposal/treatment in accordance with USEPA regulations.

The generation of hazardous IDW should be minimized to conserve Division resources. Most routine studies should not produce any hazardous IDW, with the possible exception of spent solvents and, possibly, purged groundwater. The use of solvents during field cleaning of equipment should be minimized by using solvent-free cleaning procedures for routine cleaning and decontamination (see SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205). If solvents are needed, the volume should be minimized by using only the amount necessary and by capturing the residual solvent separately from the aqueous decontamination fluids (detergent/wash water mixes and water rinses).

At a minimum, the requirements of the management of hazardous IDW are as follows:

- Spent solvents must be left on-site with the permission of site operator and proper disposal arranged.
- All hazardous IDW must be containerized. Proper handling and disposal should be arranged prior to commencement of field activities.

Table 1: Disposal of IDW

TYPE	HAZARDOUS	NON-HAZARDOUS
PPE-Disposable	Containerize in plastic 5-gallon bucket with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise return to FEC for proper disposal.	Place waste in trash bag. Place in dumpster with permission of site operator, otherwise return to FEC for disposal in dumpster.
PPE-Reusable	Decontaminate as per SESDPROC-205, if possible. If the equipment cannot be decontaminated, containerize in plastic 5-gallon bucket with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise return to FEC for proper disposal.	Decontaminate as per SESDPROC- 205.
Spent Solvents	Containerize in original containers. Clearly identify contents. Leave on-site with permission of site operator and arrange for proper disposal.	N/A
Soil Cuttings	Containerize in DOT-approved container with tight-fitting lid. Identify and leave onsite with permission of site operator, otherwise arrange with program site manager for testing and disposal.	Containerize in a 55-gallon steel drum with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal. **
Groundwater	Containerize in DOT-approved container with tight-fitting lid. Identify and leave onsite with permission of site operator, otherwise arrange with program site manager for testing and disposal.	Containerize in an appropriate container with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal. **

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Decontamination Water	Containerize in DOT-approved container with tight-fitting lid. Identify and leave onsite with permission of site operator, otherwise arrange with program site manager for testing and disposal.	Containerize in an appropriate container with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal.
Disposable Equipment	Containerize in DOT-approved container or 5-gallon plastic bucket with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal.	Containerize in an appropriate container with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal.
Trash	N/A	Place waste in trash bag. Place in dumpster with permission of site operator, otherwise return to FEC for disposal in dumpster.

** These materials may be placed on the ground if doing so does not endanger human health or the environment or violate federal or state regulations.





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Contents

1.0 General Information

1.1 Purpose

This document describes general and specific procedures, methods and considerations to be used and observed when collecting groundwater samples for field screening or laboratory analysis.

1.2 Scope/Application

The procedures contained in this document are to be used by field personnel when collecting and handling groundwater samples in the field. On the occasion that SESD field personnel determine that any of the procedures described in this section are either inappropriate, inadequate or impractical and that another procedure must be used to obtain a groundwater sample, the variant procedure will be documented in the field log book, along with a description of the circumstances requiring its use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and have been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the H: drive of the SESD local area network. The Field Quality Manager (FQM) is responsible for ensuring the most recent version of the procedure is placed on the H: drive and for maintaining records of review conducted prior to its issuance.

1.4 References

International Air Transport Authority (IATA). Dangerous Goods Regulations, Most Recent Version

Puls, Robert W., and Michael J. Barcelona. 1989. Filtration of Ground Water Samples for Metals Analysis. Hazardous Waste and Hazardous Materials 6(4), pp.385-393.

Puls, Robert W., Don A. Clark, and Bert Bledsoe. 1992. Metals in Ground Water: Sampling Artifacts and Reproducibility. Hazardous Waste and Hazardous Materials 9(2), pp. 149-162.

SESD Guidance Document, Design and Installation of Monitoring Wells, SESDGUID- 001, Most Recent Version

SESD Operating Procedure for Control of Records, SESDPROC-002, Most Recent Version

SESD Operating Procedure for Sample and Evidence Management, SESDPROC-005, Most Recent Version

SESD Operating Procedure for Logbooks, SESDPROC-010, Most Recent Version

SESD Operating Procedure for Field Sampling Quality Control, SESDPROC-011, Most Recent Version

SESD Operating Procedure for Field pH Measurement, SESDPROC-100, Most Recent Version

SESD Operating Procedure for Field Specific Conductance Measurement, SESDPROC- 101, Most Recent Version

SESD Operating Procedure for Field Temperature Measurement, SESDPROC-102, Most Recent Version

SESD Operating Procedure for Field Turbidity Measurement, SESDPROC-103, Most Recent Version

SESD Operating Procedure for Groundwater Level and Well Depth Measurement, SESDPROC-105, Most Recent Version

SESD Operating Procedure for Management of Investigation Derived Waste, SESDPROC-202, Most Recent Version

SESD Operating Procedure for Pump Operation, SESDPROC-203, Most Recent Version

SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205, Most Recent Version

SESD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC, SESDPROC-206, Most Recent Version

SESD Operating Procedure for Potable Water Supply Sampling, SESDPROC-305, Most Recent Version

United States Environmental Protection Agency (US EPA). 1975. Handbook for Evaluating Water Bacteriological Laboratories. Office of Research and Development (ORD), Municipal Environmental Research Laboratory, Cincinnati, Ohio.

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US EPA. 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. Region 4 Science and Ecosystem Support Division (SESD), Athens, GA

US EPA. Analytical Support Branch Laboratory Operations and Quality Assurance Manual. Region 4 SESD, Athens, GA, Most Recent Version

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SESD, Athens, GA, Most Recent Version

1.5 General Precautions

1.5.1 Safety

Proper safety precautions must be observed when collecting groundwater samples. Refer to the SESD Safety, Health and Environmental Management Program (SHEMP) Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASP) for guidelines on safety precautions. These guidelines should be used to complement the judgment of an experienced professional. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

1.5.2 Procedural Precautions

The following precautions should be considered when collecting groundwater samples.

- Special care must be taken not to contaminate samples. This includes storing samples in a secure location to preclude conditions which could alter the properties of the sample. Samples shall be custody sealed during long-term storage or shipment.
- Always sample from the anticipated cleanest, i.e., least contaminated location, to the most contaminated location. This minimizes the opportunity for cross-contamination to occur during sampling. Collected samples must remain in the custody of the sampler or sample custodian until the samples are relinquished to another party.

- If samples are transported by the sampler, they will remain under his/her custody or be secured until they are relinquished.
- Shipped samples shall conform to all U.S. Department of Transportation (DOT) rules of shipment found in Title 49 of the Code of Federal Regulations (49 CFR parts 171 to 179), and/or International Air Transportation Association (IATA) hazardous materials shipping requirements found in the current edition of IATA's Dangerous Goods Regulations.
- Documentation of field sampling is done in a bound logbook.
- Chain-of-custody documents shall be filled out and remain with the samples until custody is relinquished.
- All shipping documents, such as air bills, bills of lading, etc., shall be retained by the project leader and placed in the project files.

2.0 Special Sampling Considerations

2.1 Volatile Organic Compounds (VOC) Analysis

Groundwater samples for VOC analysis must be collected in 40 ml glass vials with Teflon® septa. The vial may be either preserved with concentrated hydrochloric acid or they may be unpreserved. Preserved samples have a two week holding time, whereas unpreserved samples have only a seven day holding time. In the great majority of cases, the preserved vials are used to take advantage of the extended holding time. In some situations, however, it may be necessary to use the unpreserved vials. For example, if the groundwater has a high amount of dissolved limestone, i.e., is highly calcareous, there will most likely be an effervescent reaction between the hydrochloric acid and the water, producing large numbers of fine bubbles. This will render the sample unacceptable. In this case, unpreserved vials should be used and arrangements must be confirmed with the laboratory to ensure that they can accept the unpreserved vials and meet the shorter sample holding times.

The samples should be collected with as little agitation or disturbance as possible. The vial should be filled so that there is a meniscus at the top of the vial and absolutely no bubbles or headspace should be present in the vial after it is capped. After the cap is securely tightened, the vial should be inverted and tapped on the palm of one hand to see if any undetected bubbles are dislodged. If a bubble or bubbles are present, the vial should be topped off using a minimal amount of sample to re-establish the meniscus. Care should be taken not to flush any preservative out of the vial during topping off. If, after topping off and capping the vial, bubbles are still present, a new vial should be obtained and the sample recollected.

Samples for VOC analysis must be collected using either stainless steel or Teflon® equipment, such as:

- Bailers must be constructed of stainless steel or Teflon®

- RediFlo2® submersible pumps used for sampling should be equipped with Teflon® sample delivery tubing
- Peristaltic pump/vacuum jug assemblies should be outfitted with Teflon® tubing from the water column to the transfer cap, which should also be constructed of Teflon®

2.2 Special Precautions for Trace Contaminant Groundwater Sampling

- A clean pair of new, non-powdered, disposable gloves will be worn each time a different location is sampled and the gloves should be donned immediately prior to sampling. The gloves should not come in contact with the media being sampled and should be changed any time during sample collection when their cleanliness is compromised.
- Sample containers for samples suspected of containing high concentrations of contaminants shall be stored separately.
- Sample collection activities shall proceed progressively from the least suspected contaminated area to the most suspected contaminated area if sampling devices are to be reused. Samples of waste or highly contaminated media must not be placed in the same ice chest as environmental (i.e., containing low contaminant levels) or background samples.
- If possible, one member of the field sampling team should take all the notes and photographs, fill out tags, etc., while the other members collect the samples.
- Clean plastic sheeting will be placed on the ground at each sample location to prevent or minimize contaminating sampling equipment by accidental contact with the ground surface.
- Samplers must use new, verified certified-clean disposable or nondisposable equipment cleaned according to procedures contained in SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205) or SESD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC (SESDPROC-206) for collection of samples for trace metals or organic compound analyses.

2.3 Sample Handling and Preservation Requirements

1. Groundwater samples will typically be collected from the discharge line of a pump or from a bailer, either from the pour stream of an up-turned bailer or from the stream from a bottom-emptying device. Efforts should be made to reduce the flow from either the pump discharge line or the bailer during sample collection to minimize sample agitation.
2. During sample collection, make sure that the pump discharge line or the bailer does not contact the sample container.

3. Place the sample into appropriate, labeled containers. Samples collected for VOC analysis must not have any headspace (see Section 2.1, Volatile Organic Compound Analysis). All other sample containers must be filled with an allowance for ullage.
4. All samples requiring preservation must be preserved as soon as practically possible, ideally immediately at the time of sample collection. If preserved VOC vials are used, these will be preserved with concentrated hydrochloric acid by ASB personnel prior to departure for the field investigation. All other chemical preservatives required for the remaining suite of analytes will be supplied by ASB personnel and will be added to the samples by SESD field personnel or other authorized persons. The adequacy of sample preservation will be checked after the addition of the preservative for all samples except for the samples collected for VOC analysis. Additional preservative should be added to achieve adequate preservation. Preservation requirements for groundwater samples are found in the USEPA Region 4 Analytical Support Branch Laboratory Operations and Quality Assurance Manual (ASBLOQAM), Most Recent Version.

2.4 Quality Control

If possible, a control sample should be collected from location not affected by the possible contaminants of concern and submitted with the other samples. This control sample should be collected as close to the sampled area as possible and from the same water-bearing formation. Equipment blanks should be collected if equipment is field cleaned and re-used on-site or if necessary to document that low-level contaminants were not introduced by pumps, bailers or other sampling equipment.

2.5 Records

Information generated or obtained by SESD personnel will be organized and accounted for in accordance with SESD records management procedures found in SESD Operating Procedure for Control of Records, SESDPROC-002. Field notes, recorded in a bound field logbook, will be generated, as well as chain-of-custody documentation in accordance with SESD Operating Procedure for Logbooks, SESDPROC-010 and SESD Procedure for Sample and Evidence Management, SESDPROC-005.

3.0 Groundwater Sampling Methods - Purging

3.1 General

3.1.1 Purging and Purge Adequacy



Purging is the process of removing stagnant water from a well, immediately prior to sampling, causing its replacement by ground water from the adjacent formation that is representative of actual aquifer conditions. In order to determine when a well has been adequately purged, field investigators should monitor the pH, specific conductance, temperature, and turbidity of the ground water removed during purging and, in the case of permanent monitoring wells, observe and record the volume of water removed.

Prior to initiating the purge, the amount of water standing in the water column (water inside the well riser and screen) should be determined, if possible. To do this, the diameter of the well should be determined and the water level and total depth of the well should be measured and recorded. Specific methodology for obtaining these measurements is found in SEDS Operating Procedure for Groundwater Level and Well Depth Measurement (SESDPROC-105). Once this information is obtained, the volume of water to be purged can be determined using one of several methods. One is the equation:

$$V = 0.041 d^2h$$

Where: h = depth of water in feet

d = diameter of well in inches

V = volume of water in gallons

Alternatively, the volume may be determined using a casing volume per foot factor for the appropriate diameter well, similar to that in Table 3.1.1. The water level is subtracted from the total depth, providing the length of the water column. This length is multiplied by the factor in the Table 3.1.1 which corresponds to the appropriate well diameter, providing the amount of water, in gallons, contained in the well, i.e., one well or water column volume. Other acceptable methods include the use of nomographs or other equations or formulae.

With respect to volume, an adequate purge is normally achieved when three to five well volumes have been removed. The field notes should reflect the single well volume calculations or determinations, according to one of the above methods, and a reference to the appropriate multiplication of that volume, i.e., a minimum three well volumes, clearly identified as a purge volume goal.

With respect to the ground water chemistry, an adequate purge is achieved when the pH, specific conductance, and temperature of the ground water have stabilized and the turbidity has either stabilized or is below 10 Nephelometric Turbidity Units (NTUs) (twice the Primary Drinking Water Standard of 5 NTUs). Although 10 NTUs is normally considered the minimum goal for most ground water sampling objectives, lower turbidity has been shown to be easily achievable in most situations and reasonable attempts should be made to achieve these lower levels. Stabilization occurs when, for at least three consecutive measurements, the pH remains constant within 0.1 Standard Unit (SU), specific conductance varies no more

than approximately 10 percent, and the temperature is constant. There are no set criteria for establishing how many total sets of measurements are adequate to document stability of parameters. If the calculated purge volume is small, the measurements should be taken frequently enough to provide a sufficient number of measurements to evaluate stability. If the purge volume is large, measurements taken every 15 minutes, for example, may be sufficient. See the SESD Operating Procedure for Field pH Measurement (SESDPROC-100), SESD Operating Procedure for Field Specific Conductance Measurement (SESDPROC-101), SESD Operating Procedure for Field Temperature Measurement (SESDPROC-102) and SESD Operating Procedure for Field Turbidity Measurement (SESDPROC-103) for procedures for conducting these purge adequacy measurements.

If, after three well volumes have been removed, the chemical parameters have not stabilized according to the above criteria, additional well volumes (up to five well volumes), should be removed. If the parameters have not stabilized within five volumes, it is at the discretion of the project leader whether or not to collect a sample or to continue purging. If, after five well volumes, pH and conductivity have stabilized and the turbidity is still decreasing and approaching an acceptable level, additional purging should be considered to obtain the best sample possible, with respect to turbidity. The conditions of sampling should be noted in the field log.

In some situations, even with slow purge rates, a well may be pumped or bailed dry (evacuated). In these situations, this generally constitutes an adequate purge and the well can be sampled following sufficient recovery (enough volume to allow filling of all sample containers). ***It is not necessary that the well be evacuated three times before it is sampled.*** The pH, specific conductance, temperature, and turbidity should be measured and recorded, during collection of the sample from the recovered volume, as the measurements of record for the sampling event.

For wells with slow recovery, attempts should be made to avoid purging them to dryness. This can be accomplished, for example, by slowing the purge rate. If a well is purged to dryness, it may result in the sample being comprised partially of water contained in the sand pack, which may be reflective, at least in part, of initial, stagnant conditions. Additionally, as water enters a well that has been purged to dryness, it may cascade down the sand pack and/or the well screen, stripping volatile organic constituents that may be present and/or introducing soil fines into the water column.

It is particularly important that wells be sampled as soon as possible after purging. If adequate volume is available immediately upon completion of purging, the well must be sampled immediately. If not, sampling should occur as soon as adequate volume has recovered. Sampling of wells which have a slow recovery should be scheduled so that they can be purged and sampled in the same day, after adequate volume has recovered. Wells of this type should not be purged at the end of one day and sampled the following day.

TABLE 3.1.1
WELL CASING DIAMETER vs. VOLUME

WELL CASING DIAMETER (INCHES) vs. VOLUME (GALS.)/FEET of WATER	
CASING	GALLONS/FT
1	0.041
2	0.163
3	0.367
4	0.653
5	1.02
6	1.469
7	1.999
8	2.311
9	3.305
10	4.08
11	4.934
12	5.875

3.1.2 Equipment Considerations for Purging

Monitoring well purging is preferably accomplished by using in-place plumbing and dedicated pumps or by using portable pumps/equipment when dedicated systems are not present. The equipment utilized by Branch personnel will usually consist of peristaltic pumps and variable speed electric submersible pumps, but may also include bladder pumps or inertial pumps. The pump of choice is usually a function of the well diameter, the depth to water, the depth of the well and the amount of water that is to be removed during purging. Whenever the head difference between the sampling location and the water level is less than the limit of suction and the volume to be removed is reasonably small, a peristaltic pump should be used for purging. For wells where the water level is below the limit of suction and/or there is a large volume of water to be purged, the variable speed electric submersible pump would be the pump of choice. SESD Operating Procedure for Pump Operation (SESDPROC-203) contains the use and operating instructions for all pumps commonly used during SESD ground water investigations.

Bailers may also be used for purging in appropriate situations; however, their use is discouraged. Bailers tend to disturb any sediment that may be present in the well, creating or increasing sample turbidity. If a bailer is used, it should be a closed-top Teflon® bailer.

3.2 Wells Without Plumbing or In-Place Pumps

For permanent monitoring wells, the depth to water (water level) and depth of the well (total depth) should be determined before purging. Caution should be exercised during this

procedure to prevent cross-contamination between wells. This is a critical concern when samples for trace organic compounds or metals analyses are collected. See SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC- 205) for cleaning procedures for well sounders. After cleaning, the well sounding device should be protected to keep it clean until its next use.

3.2.1 Purging with Pumps

3.2.1.1 Peristaltic Pumps

The following step-by-step procedures describe the process of purging with a peristaltic pump:

1. Cut a length of standard-cleaned (SESD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC (SESDPROC- 206) Teflon® tubing, equal to the well depth plus an additional five to ten feet. Enough tubing is needed to run from the ground surface up to the top of the well casing and back down to the bottom of the well. This will allow for operation of the pump at all possible water level conditions in the well.
2. Place one end of the tubing into the vacuum side of the peristaltic pump head. Proper sizing of the Teflon® and Silastic® or Tygon® tubing should allow for a snug fit of the Teflon® tubing inside the flexible tubing mounted in the pump head.
3. Run a short section of tubing (does not have to be Teflon®) from the discharge side of the pump head to a graduated bucket.
4. Place the free end of the Teflon® tubing into the well until the end of the tubing is just below the surface of the water column.
5. Secure the Teflon® tubing to the well casing or other secure object using electrician's tape or other suitable means. This will prevent the tubing from being lost in the well should the tubing detach from the pump head.
6. Turn on the pump to produce a vacuum on the well side of the pump head and begin the purge. Observe pump direction to ensure that a vacuum is being applied to the purge line. If the purge line is being pressurized, either switch the tubing at the pump head or reverse the polarity of the cables on the pump or on the battery.
7. If the pumping rate exceeds the recovery rate of the well, continue to lower the tubing into the well, as needed, until the drawdown stabilizes or the well is evacuated to dryness. If the pump is a variable speed peristaltic pump, and the water level in the well is being drawn down, reduce the speed of the pump in an attempt to stabilize the drawdown. If the well can be purged without evacuating the well to dryness, a sample with greater integrity can be obtained.
8. For wells which are not evacuated to dryness, particularly those with recovery rates equal to or very nearly equal to the purge rate, there may not be a complete exchange and removal of stagnant water in that portion of the water column above the tubing intake. For this reason, it is important that the tubing intake be placed in the very uppermost portion of the water column while purging. Standard field measurements

should frequently be taken during this process to verify adequacy of the purge and readiness for sampling, as described in Section 3.

3.2.1.2 Submersible Pumps

When a submersible pump is used for well purging, the pump itself is lowered into the water column. The pump must be cleaned as specified in SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205).

The pump/hose assembly used in purging should be lowered into the top of the standing water column and not deep into the column. This is done so that the purging will "pull" water from the formation into the screened area of the well and up through the casing so that the entire static volume can be removed. If the pump is placed deep into the water column, the water above the pump may not be removed, and the subsequent samples, particularly if collected with a bailer, may not be representative of the aquifer conditions. It is recommended that no more than three to five feet of hose be lowered into the water column. If the recovery rate of the well is faster than the pump rate and no observable draw down occurs, the pump should be raised until the intake is within one foot of the top of the water column for the duration of purging. If the pump rate exceeds the recovery rate of the well, the pump will have to be lowered, as needed, to accommodate the drawdown. After the pump is removed from the well, the hose and the pump should be cleaned as outlined in SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205).

3.2.2 Purging With Bailers

Standard-cleaned (SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205) or SESD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC (SESDPROC-206) closedtop Teflon® bailers with Teflon® coated stainless steel leaders and new nylon rope are lowered into the top of the water column, allowed to fill, and removed. It is critical that bailers be slowly and gently immersed into the top of the water column, particularly during final stages of purging, to minimize turbidity and disturbance of volatile organic constituents. The use of bailers for purging and sampling is discouraged because the correct technique is highly operator dependent and improper use may result in an unrepresentative sample.

3.2.3 Field Care of Purging Equipment

New plastic sheeting should be placed on the ground surface around the well casing to prevent contamination of the pumps, hoses, ropes, etc., in the event they accidentally come into contact with the ground surface or, for some reason, they need to be placed on the ground during the purging event. It is preferable that hoses used in purging that come into contact with the ground water be kept on a spool or contained in a large wash tub lined with

plastic sheeting, both during transportation and during field use, to further minimize contamination by the transporting vehicle or the ground surface.

Careful consideration shall be given to using submersible pumps to purge wells which are excessively contaminated with oily compounds, because it may be difficult to adequately decontaminate severely contaminated pumps under field conditions. When wells of this type are encountered, alternative purging methods, such as bailers, should be considered.

3.2.4 General Low Flow/Low Stress Method Preference

The device with the lowest pump or water removal rate and the least tendency to stress the well during purging should be selected for use. For example, if a bailer and a peristaltic pump both work in a given situation, the pump should be selected because it will greatly minimize turbidity, providing a higher quality sample (Sec. 3.4.2, Purging When Water Level Is Within Limit of Suction, contains a description of low flow purging and sampling with a peristaltic pump used in a temporary well).

3.2.5 Low Flow/Low Volume Purging Techniques/Procedures

An alternative to the low flow/low stress purging method is the low flow/low volume method, commonly referred to as the “micro-purge” method. The low flow/low volume purging method is a procedure developed and used to minimize purge water volumes. The pump intake is placed within the screened interval at the zone of sampling, preferably, the zone with the highest flow rate. Low flow rate purging is conducted after hydraulic conditions within the well have restabilized, usually within 24 to 48 hours. Flow rates should not exceed the recharge rate of the aquifer. This is monitored by measuring the top of the water column with a properly cleaned water level indicator or similar device while pumping. This method is not considered to be a standard method by the Branch and is only acceptable under certain hydraulic conditions. Its use must be evaluated on a case-by-case basis.

3.3 Wells With In-Place Plumbing

Wells with in-place plumbing are commonly found at municipal water treatment plants, industrial water supplies, private residences, etc. Many permanent monitoring wells at active facilities are also equipped with dedicated, in-place pumps. The objective of purging wells with in-place pumps is the same as with monitoring wells without in-place pumps, i.e., to ultimately collect a ground water sample representative of aquifer conditions. Among the types of wells identified in this section, two different approaches are necessary.

A permanent monitoring well with an in-place pump should, in all respects, be treated like a monitoring well without a pump. One limitation is that in most cases the in-place pump is “hard” mounted, that is, the pump is suspended in the well at a pre-selected depth and cannot be moved up or down during purging and sampling. In these cases, well volumes are calculated, parameters are measured and the well is sampled from the pump discharge, after volume removal and parameter conditions have been met.

In the case of the other types of wells, i.e., municipal, industrial and residential supply wells, however, not enough is generally known about the construction aspects of the wells to apply the same criteria as used for monitoring wells, i.e., 3 to 5 well volumes. The volume to be purged in these situations, therefore, depends on several factors: whether the pumps are running continuously or intermittently and whether or not any storage/pressure tanks are located between the sampling point and the pump. The following considerations and procedures should be followed when purging wells with in-place plumbing under the conditions described.

3.3.1 Continuously Running Pumps

If the pump runs more or less continuously, no purge (other than opening a valve and allowing it to flush for a few minutes) is necessary. If a storage tank is present, a spigot, valve or other sampling point should be located between the pump and the storage tank. If not, locate the valve closest to the tank. Measurements of pH, specific conductance, temperature, and turbidity are recorded at the time of sampling.

3.3.2 Intermittently or Infrequently Running Pumps

If the pump runs intermittently or infrequently, best judgment should be utilized to remove enough water from the plumbing to flush standing water from the piping and any storage tanks that might be present. Generally, under these conditions, 15 to 30 minutes will be adequate. Measurements of pH, specific conductance, temperature and turbidity should be made and recorded at intervals during the purge and the final measurements made at the time of sampling should be considered the measurements of record for the event.

3.4 Temporary Monitoring Wells

3.4.1 General Considerations

Procedures used to purge temporary ground water monitoring wells differ from permanent wells because temporary wells are installed for immediate sample acquisition. Wells of this type may include standard well screen and riser placed in boreholes created by hand augering, power augering, or by drilling. They may also consist of a rigid rod and screen that is pushed, driven, or hammered into place to the desired sampling interval, such as a direct push Wellpoint®, a Geoprobe® Screen Point 15 sampler or a Hydropunch® sampler. As such, the efforts to remove several volumes of water to replace stagnant water do not necessarily apply because stagnant water is not present. It is important to note, however, that the longer a temporary well is in place and not sampled, the more stagnant the water column becomes and the more appropriate it becomes to apply, to the extent possible, standard permanent monitoring well purging criteria to it to re-achieve aquifer conditions.

In cases where the temporary well is to be sampled immediately after installation, purging is conducted primarily to mitigate the impacts of installation. In most cases, temporary well

installation procedures disturb the existing aquifer conditions, resulting primarily in increased turbidity. Therefore, the goal of purging is to reduce the turbidity and remove the volume of water in the area directly impacted by the installation procedure. Low turbidity conditions in these types of wells that are completed within the limit of suction are typically and routinely achieved by the use of low-flow/low stress purging techniques using variable speed peristaltic pumps.

3.4.2 Purging When Water Level Is Within Limit of Suction

In situations where the elevation of the top of the water column is within the limit of suction (no greater than about 25 feet head difference between the pump and the water level), a variable speed peristaltic pump may be used to purge temporary wells. Enough tubing is deployed to reach the bottom of the temporary well screen. At the onset of purging, the tubing is slowly lowered to the bottom of the screen and is used to remove any formation material which may have entered the well screen during installation. This is critical to ensuring rapid achievement of low turbidity conditions. After the formation material is removed from the bottom of the screen, the tubing is slowly raised through the water column to near the top of the column. The tubing can be held at this level to determine if the pump rate is drawing down the water level in the well. If the water level remains the same, secure the tubing at the surface to maintain this pumping level.

If drawdown is observed on initiation of pumping, reduce the pump speed and attempt to match the drawdown of the well. Sustained pumping at these slow rates will usually result in a relatively clear, low turbidity sample. If the drawdown stabilizes, maintain that level, however, if it continues to lower, "chase" the water column until the well is evacuated. In this case, the recovered water column may be relatively free of turbidity and can be sampled. It may take several episodes of recovery to provide enough volume for a complete sample.

3.4.3 Purging When Water Level Is Greater Than Limit of Suction

In situations where the elevation of the water table is greater than the limit of suction, peristaltic pumps cannot be used to purge temporary wells. If the temporary well is a ScreenPoint15® sampler with small diameter probe rod riser, the only practical choices for water removal are a small diameter bailer, a small diameter bladder pump or an inertial pump. If the well is to be used strictly for VOC screening, it may be acceptable to use the bailer to bail as much sediment from the well as possible prior to sampling. If metals are the analytes of concern, the bladder pump is the best choice for lowering the turbidity of the water column prior to sampling, followed next by the inertial pump. For larger diameter temporary wells, two-inch diameter or greater, bailers and the Grundfos® RediFlo2 may be used although excessive silt or other "fines" may present problems with the operation of the pump.

3.4.4 Considerations for Direct Push Groundwater Sampling

With many of the direct push sampling techniques, purging is either not practical or possible, therefore, no purging is conducted. The sampling device is simply pushed or driven to the desired depth and opened and the sample is collected and retrieved. As a result, some samples collected in this way may not be satisfactory or acceptable for certain analyses, i.e., the subject procedure may yield a turbid sample that is not appropriate for metals analyses.

3.5 Investigation Derived Waste

Purging generates quantities of purge water or investigation derived waste (IDW), the disposition of which must be considered. See SESD Operating Procedure for Management of Investigation Derived Waste (SESDPROC-202) for guidance on management or disposal of this waste.

4.0 Groundwater Sampling Methods – Sampling

4.1 General

Sampling is the process of obtaining, containerizing, and preserving (if required) a ground water sample after the purging process is complete. Non-dedicated pumps for sample collection generally should not be used. Many pumps are made of materials such as brass, plastic, rubber, or other elastomer products which may cause chemical interferences with the sample. Their principle of operation may also render them unacceptable as a sample collection device. It is recognized that there are situations, such as industrial or municipal supply wells or private residential wells, where a well may be equipped with a dedicated pump from which a sample would not normally be collected. Discretion should always be used in obtaining a sample.

4.2 Sampling Wells With In-Place Plumbing

Samples should be collected following purging from a valve or cold water tap as near to the well as possible, preferably prior to any storage/pressure tanks or physical/chemical treatment system that might be present. Remove any hose that may be present before sample collection and reduce the flow to a low level to minimize sample disturbance, particularly with respect to volatile organic constituents. Samples should be collected directly into the appropriate containers as specified in the ASBLOQAM. It may be necessary to use a secondary container, such as a clean 8 oz. or similar size sample jar or a stainless steel scoop, to obtain and transfer samples from spigots with low ground clearance. Also, refer to the discussion in the SESD Operating Procedure for Potable Water Supply Sampling (SESDPROC-305), Sec. 4.2, Potable Water Samples Collected from Wells with In-Place Plumbing. Potable well measurements for pH, specific conductance, temperature, and turbidity should be recorded at the time of sample collection.

4.3 Sampling Wells without Plumbing, Within the Limit of Suction

4.3.1 Equipment Available

The pump of choice for sampling ground water within the limit of suction is the variable-speed peristaltic pump. Its use is described in the following sections. Other acceptable alternatives that may be used under these conditions are the RediFlo2® electric submersible pump (with Teflon® tubing) and a closed-top Teflon® bailer

4.3.1.1 Peristaltic Pump, Direct from Pump Head Tubing

Samples for some constituents, primarily inorganic analytes such as metals and cyanide, may be collected directly from the pump head tubing. This method is acceptable under the following conditions:

- The pump head tubing must be changed between sampling locations;
- The pump head tubing must be either be certified clean according to SESD's internal quality control program described in Section 3.2 of the SESD Operating Procedure for Field Sampling Quality Control (SESDPROC-011) or
- An equipment rinsate blank is collected by pumping de-ionized water through a piece of the tubing.

4.3.1.2 Peristaltic pump/vacuum jug

It is not acceptable to collect samples for organic compounds analyses through the flexible tubing used in the pump head. When collecting samples for organic compound analyses it is necessary to use a vacuum container, placed between the pump and the well for sample collection. The following step-by-step procedures describe the process of sampling with a peristaltic pump and vacuum jug (see note following these procedures for collection of VOC samples):

1. Disconnect the purge tubing from the pump. Make sure the tubing is securely attached to the protective casing or other secure object.
2. Insert the tubing into one of the ferrule nut fittings of a Teflon® vacuum container transfer cap assembly.
3. Place a suitable length of Teflon® tubing between the remaining transfer cap assembly ferrule nut fitting and the vacuum side of the flexible tubing in the peristaltic pump head. Securely hand-tighten both fittings.
4. Turn the pump on. Water should begin to collect in the transfer container (typically a 1-liter sample container) within a few minutes. If water does not begin to flow into the container within several minutes, check the transfer cap fittings and make sure the assembly is tightly attached to the container. It may be necessary to tighten the ferrule nuts with a wrench or pliers to achieve a vacuum in the system, particularly when approaching the maximum head difference between the pump and water table (limit of suction).
5. When the transfer container is nearly full, turn off the pump, remove the transfer cap assembly, and pour the sample into the appropriate containers. Because the 1-liter containers used by the Branch are rinsed with nitric acid during cleaning, they cannot be used for collecting samples to be analyzed for nitrogen sensitive parameters.
6. If additional sample volume is needed, replace the transfer cap assembly, turn the pump on, and collect additional volume. The use of Teflon® valves or ball check devices to retain the water column in the sample delivery tubing during the transfer phase, when large volumes of sample are required, is acceptable. These devices, however, must be constructed so that they may be completely disassembled and cleaned according to the procedures in SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205).
7. When sampling is completed, all Teflon® tubing should be discarded.

NOTE: Samples for volatile organic compound analyses cannot be collected using this method. If samples for VOC analyses are required, they must be collected with a Teflon® or stainless steel bailer or by other approved methods, such as the “soda straw” method. The “soda straw” method involves allowing the tubing to fill, by either lowering it into the water column (A) or by filling it via suction applied by the pump head (B). If method (A) is used, the tubing is removed from the well after filling and the captured sample is allowed to drain into the sample vial. If method (B) is used, after running the pump and filling the tubing with sample, the pump speed is reduced and the direction reversed to push the sample out of the tubing into the vials. Avoid completely emptying the tubing when filling the sample vials when using method (B) to prevent introducing water that was in contact with the flexible pump head tubing. Either method is repeated, as necessary, until all vials are filled.

4.3.1.3 RediFlo2® Electric Submersible Pump (with Teflon® tubing)

After purging has been accomplished with RediFlo2® electric submersible pump, the sample may be obtained directly from the pump discharge, provided that Teflon® tubing was used for the sample delivery line. The discharge rate of the pump should be reduced during volatile organic compound sample collection to minimize sample disturbance. Note, if the RediFlo2® electric submersible pump is used for sampling, the water in the cooling chamber must be replaced with organic-free water between each well and the pump must undergo a full external and internal cleaning. In addition, pump rinsate blanks must be collected, at the appropriate frequency, to demonstrate that the pump has been adequately cleaned between wells.

4.3.1.4 Bailers

New bailer rope should be attached to the bailer via a Teflon® coated stainless steel wire. (If a bailer was used to purge the well, it may also be used to sample the well and new bailer rope is not required between purging and sampling). The bailer should be gently immersed in the top of the water column until just filled. At this point, the bailer should be slowly removed and the contents emptied into the appropriate sample containers.

4.4 Sampling Wells without Plumbing, Exceeding the Limit of Suction

All methods described previously in Section 4.3.2.1.3, RediFlo2® Electric Submersible Pumps, and Section 4.3.2.1.4, Bailers, are suitable sample methods where the water table is too deep to consider the use of a peristaltic pump for sampling.

4.5 Sample Preservation

After sample collection, all samples requiring preservation must be preserved as soon as practical. Consult the ASBLOQAM for the correct preservative for the particular analytes of

interest. All samples preserved using a pH adjustment (except VOCs) must be checked, using pH strips, to ensure that they were adequately preserved. This is done by pouring a small volume of sample over the strip. Do not place the strip in the sample. Samples requiring reduced temperature storage should be placed on ice immediately.

4.6 Special Sample Collection Procedures

4.6.1 Trace Organic Compounds and Metals

Special sample handling procedures should be instituted when trace contaminant samples are being collected. All sampling equipment, including pumps, bailers, water level measurement equipment, etc., which comes into contact with the water in the well must be cleaned in accordance with the cleaning procedures described in the SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205 or SESD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC (SESDPROC-206). Pumps should not be used for sampling unless the interior and exterior portions of the pump and the discharge hoses are thoroughly cleaned. Blank samples should be collected to determine the adequacy of cleaning prior to collection of any sample using a pump other than a peristaltic pump.

4.6.2 Order of Sampling with Respect to Analytes

In many situations when sampling permanent or temporary monitoring wells, an adequate purge, with respect to turbidity, is often difficult to achieve. Removal and insertion of equipment after the purge and prior to actual sampling may negate the low turbidities achieved during purging and elevate turbidity back to unacceptable levels. For this reason, it is important that special efforts be used to minimize any disturbance of the water column after purging and to collect the aliquot for metals first. Therefore, the preferred order of sampling is metals first, followed by other inorganic analytes, extractable organic compounds and volatile organic compounds.

4.6.3 Filtering

As a standard practice, ground water samples will not be filtered for routine analysis. Filtering will usually only be performed to determine the fraction of major ions and trace metals passing the filter and used for flow system analysis and for the purpose of geochemical speciation modeling. Filtration is not allowed to correct for improperly designed or constructed monitoring wells, inappropriate sampling methods, or poor sampling technique.

When samples are collected for routine analyses and are filtered, both filtered and non-filtered samples will be submitted for analyses. Samples for organic compounds analysis should not be filtered. Prior to filtration of the ground water sample for any reason other than

geochemical speciation modeling, the following criteria must be demonstrated to justify the use of filtered samples for inorganic analysis:

1. The monitoring wells, whether temporary or permanent, have been constructed and developed in accordance with the SESD Guidance Document, Design and Installation of Monitoring Wells (SESDGUID-001).
2. The ground water samples were collected using sampling techniques in accordance with this section, and the ground water samples were analyzed in accordance with USEPA approved methods.
3. Efforts have been undertaken to minimize any persistent sample turbidity problems. These efforts may consist of the following:
 - Redevelopment or re-installation of permanent ground water monitoring wells.
 - Implementation of low flow/low stress purging and sampling techniques.
4. Turbidity measurements should be taken during purging and sampling to demonstrate stabilization or lack thereof. These measurements should be documented in the field notes. If the ground water sample appears to have either a chemically-induced elevated turbidity, such as would occur with precipitate formation, or a naturally elevated colloid or fine, particulate-related turbidity, filtration will not be allowed.

If filtration is necessary for purposes of geochemical modeling or other **pre-approved** cases, the following procedures are suggested:

1. Accomplish in-line filtration through the use of disposable, high capacity filter cartridges (barrel-type) or membrane filters in an in-line filter apparatus. The high capacity, barrel-type filter is preferred due to the higher surface area associated with this configuration. If a membrane filter is utilized, a minimum diameter of 142 mm is suggested.
2. Use a 5 μm pore-size filter for the purpose of determining the colloidal constituent concentrations. A 0.1 μm pore-size filter should be used to remove most non-dissolved particles.
3. Rinse the cartridge or barrel-type filter with 500 milliliters of the solute (ground water to be sampled) prior to collection of sample. If a membrane filter is used, rinse with 100 milliliters of solute prior to sample collection.

Potential differences could result from variations in filtration procedures used to process water samples for the determination of trace element concentrations. A number of factors associated with filtration can substantially alter "dissolved" trace element concentrations; these include filter pore size, filter type, filter diameter, filtration method, volume of sample processed, suspended sediment concentration, suspended sediment grain-size distribution, concentration of colloids and colloidally-associated trace elements, and concentration of

organic matter. Therefore, consistency is critical in the comparison of short-term and long-term results. Further guidance on filtration may be obtained from the following: 1) Metals in Ground Water: Sampling Artifacts and Reproducibility; 2) Filtration of Ground Water Samples for Metals Analysis; and 3) Ground Water Sampling - A Workshop Summary. See Section 1.4, References, for complete citation for these documents.

Bacterial Sampling

Whenever wells (normally potable wells) are sampled for bacteriological parameters, care must be taken to ensure the sterility of all sampling equipment and all other equipment entering the well. Further information regarding bacteriological sampling is available in the following: 1) Sampling for Organic Chemicals and Microorganisms in the Subsurface; 2) Handbook for Evaluating Water Bacteriological Laboratories; and 3) Microbiological Methods for Monitoring the Environment, Water and Wastes. See Section 1.4, References, for complete citation for these documents.

4.7 Specific Sampling Equipment Quality Assurance Techniques

All equipment used to collect ground water samples shall be cleaned as outlined in the SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205) or SESD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC (SESDPROC-206) and repaired, if necessary, before being stored at the conclusion of field studies. Cleaning procedures utilized in the field or field repairs shall be thoroughly documented in field records.

4.8 Auxiliary Data Collection

During ground water sample collection, it is important to record a variety of ground water related data. Included in the category of auxiliary data are water levels measured according to the SESD Operating Procedure for Groundwater Level and Well Depth Measurement (SESDPROC-105), well volume determinations (Section 3.1.1, Purging and Purge Adequacy), pumping rates during purging (see below), and occasionally, drillers or boring logs. This information should be documented in the field records.

4.8.1 Well Pumping Rate - Bucket/Stop Watch Method

The pumping rate for a pump can be determined by collecting the discharge from the pump in a bucket of known volume and timing how long it takes to fill the bucket. The pumping rate should be in gallons per minute. This method shall be used primarily with pumps with a constant pump rate, such as gasoline-powered or electric submersible pumps. Care should be taken when using this method with some battery-powered pumps. As the batteries' charge decreases, the pump rate also decreases so that pumping rate calculations using initial, high pump rates may be erroneously high. If this method is used with battery-powered pumps, the rate should be re-checked frequently to ensure accuracy of the pumping rate calculations.



ENVIRONMENTAL SERVICES

STANDARD OPERATING PROCEDURES

GROUNDWATER LEVEL AND WELL DEPTH MEASUREMENT K-Plus SOP Number 5

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Contents

1.0 General Information

1.1 Purpose

This document describes general and specific procedures, methods and considerations to be used and observed when determining water levels and depths of wells.

1.2 Scope/Application

The procedures contained in this document are to be used by field investigators to measure water levels and depths of wells. On the occasion that SESD field investigators determine that any of the procedures described in this section are either inappropriate, inadequate or impractical and that another procedure must be used for water level or depth determination, the variant procedure(s) will be documented in the field log book and the subsequent investigation report, along with a description of the circumstances requiring its use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and has been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the H: drive of the SESD local area network. The Field Quality Manager is responsible for ensuring the most recent version of the procedure is placed on the H: drive and for maintaining records of review conducted prior to its issuance.

1.4 References

SESD Operating Procedure for Equipment Inventory and Management, SESDPROC-108, Most Recent Version

SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205, Most Recent Version

SESD Operating Procedure for Logbooks, SESDPROC-010, Most Recent Version

United States Environmental Protection Agency (US EPA). 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. Region 4 Science and Ecosystem Support Division (SESD), Athens, GA

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SESD, Athens, GA, Most Recent Version

1.5 General Precautions

1.5.1 Safety

Proper safety precautions must be observed when measuring water levels in wells and determining their depths. Refer to the SESD Safety, Health and Environmental Management Program Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASPs) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

1.5.2 Procedural Precautions

The following precautions should be considered when measuring water levels and depths of wells:

- Special care must be taken to minimize the risk of cross-contamination between wells when conducting water level and depth measurements. This is accomplished primarily by decontaminating the sounders or other measuring devices between wells, according to SESD Operating Procedure for Field Equipment Cleaning and Decontamination, (SESDPROC-205) and maintaining the sounders in clean environment while in transit between wells.
- Water levels and well depths measured according to these procedures should be recorded in a bound logbook dedicated to the project as per SESD Operating Procedure for Logbooks (SESDPROC-010). Serial numbers, property numbers or other unique identification for the water level indicator or sounder must also be recorded.

2.0 Quality Control Issues

There are several specific quality control issues pertinent to conducting water level and depth measurements at wells. These are:

- Devices used to measure groundwater levels should be calibrated annually against the Invar® steel surveyor's chain. These devices should be calibrated to 0.01 foot per 10 feet of length. Before each use, these devices should be prepared according to the manufacturer's instructions (if appropriate) and checked for obvious damage. All calibration and maintenance data should be documented electronically and recorded in a log book maintained at the Field Equipment Center (FEC) as per the SESD Operating Procedure for Equipment Inventory and Management (SESDPROC-108).
- These devices should be decontaminated according to the procedures specified in SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205) prior to use at the next well.

3.0 Water Level and Depth Measurement Procedures

3.1 General

The measurement of the groundwater level in a well is frequently conducted in conjunction with ground water sampling to determine the “free” water surface. This potentiometric surface measurement can be used to establish ground water direction and gradients. Groundwater level and well depth measurements are needed to determine the volume of water in the well casing prior to purging the well for sampling purposes.

All groundwater level and well depth measurements should be made relative to an established reference point on the well casing and should be documented in the field records. This reference point is usually identified by the well installer using a permanent marker, for PVC wells, or by notching the top of casing with a chisel, for stainless steel wells. By convention, this marking is usually placed on the north side of the top of casing. If no mark is apparent, the person performing the measurements should take both water level and depth measurements from the north side of the top of casing and note this procedure in the field log book.

To be useful for establishing groundwater gradient, the reference point should be tied in with the NGVD (National Geodetic Vertical Datum) or a local datum. For an isolated group of wells, an arbitrary datum common to all wells in that group may be used, if necessary, and is acceptable.

3.2 Specific Groundwater Level Measurement Techniques

Measuring the depth to the free ground water surface can be accomplished by the following methods. Method accuracies are noted for each of the specific methods described below.

- **Electronic Water Level Indicators** – These types of instruments consist of a spool of dual conductor wire, a probe attached to the end and an indicator. When the probe comes in contact with the water, the circuit is closed and a meter light and/or audible buzzer attached to the spool will signal contact. Penlight or 9-volt batteries are normally used as a power source. Measurements should be made and recorded to the nearest 0.01 foot.
- **Other Methods** – There are other types of water level indicators and recorders available on the market, such as weighted steel tape, chalked tape, sliding float method, air line pressure method and automatic recording methods. These methods are primarily used for closed systems or permanent monitoring wells. Acoustic water level indicators are also available which measure water levels based on the measured return of an emitted acoustical impulse. Accuracies for these methods vary and should be evaluated before selection. Any method not capable of providing measurements to within 0.1 foot should not be used.

3.3 Total Well Depth Measurement Techniques

The well sounder, weighted tape or electronic water level indicators can be used to determine the total well depth. This is accomplished by lowering the tape or cable until the weighted end is felt resting on the bottom of the well. Because of tape buoyancy and weight effects encountered in deep wells with long water columns, it may be difficult to determine when the tape end is touching the bottom of the well. Sediment in the bottom of the well can also make it difficult to determine total depth. Care must be taken in these situations to ensure accurate measurements. All total depth measurements must be made and recorded to the nearest 0.1 foot. As a cautionary note, when measuring well depths with the electronic water level indicators, the person performing the measurement must measure and add the length of the probe beneath the circuit closing electrodes to the depth measured to obtain the true depth. This is necessary because the tape distance markings are referenced to the electrodes, rather than the very end of the probe.

3.4 Equipment Available

The following equipment is available for ground water level and total depth measurements:

- Weighted steel measuring tapes
- Electronic water level indicators



ENVIRONMENTAL SERVICES

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INSITU WATER QUALITY MONITORING
K-Plus SOP Number 6

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Contents

1.0 General Information

1.1 Purpose

The purpose of this procedure is to document acceptable practices in the use of multiparameter data sondes in the monitoring of in situ water quality parameters and dye tracer.

1.2 Scope/Application

This procedure covers the use of multiparameter data sondes for monitoring of in situ water quality including real-time measurement, profiling, and unattended data logging. In situ water quality parameters may include dissolved oxygen (DO), temperature, pH, conductivity, turbidity, and chlorophyll. This procedure also applies to use of data sondes for monitoring dye tracer.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and has been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the H: drive of the SESD local area network. The Field Quality Manager (FQM) is responsible for ensuring the most recent version of the procedure is placed on the H: drive and for maintaining records of review conducted prior to its issuance.

1.4 Precautions

1.4.1 Safety

Equipment must be handled in a safe manner. Safety issues related to calibration or measurement of a specific parameter are addressed in individual parameter procedures. In addition, safety precautions should be followed in the deployment of data sondes. For unattended deployment in wadeable systems, data sondes should only be deployed and retrieved under safe flow/stage conditions. When deploying from a bridge, an amber flashing light should be operated on the roof of the field vehicle. When deploying from a boat, standard boating safety procedures should be followed. The SESD Safety, Health and Environmental Management Program Procedures and Policy Manual provides more information regarding field safety.

1.4.2 Equipment Handling

To ensure the safe and reliable operation of equipment, the manufacturers' directions for transport, cleaning, decontamination, storage, and operation shall be followed. In general,

upon return from the field and applicable data downloading, the batteries should be removed from the data sonde and the sonde washed via light brushing in warm, soapy water. Each probe should be cleaned and stored as directed by the manufacturer.

Prior to use, data sondes should be signed out in the instrument log book according to SESD Operating Procedure for Equipment Inventory and Management (SESDPROC-108). When unattended deployment is anticipated, pingers should be attached to the sonde, as feasible, to aid in recovery should the sonde be displaced during deployment.

1.4.3 Calibration

Prior to use, each sonde probe should be calibrated according to the specific parameter measurement procedure. However, because the sonde is a multi-probe unit, additional care must be taken to prevent cross-contamination of calibration standards. Similarly, calibration of multiple sonde units requires crosscontamination prevention procedures. Specifically, following immersion of the sonde probes into each calibration standard, all probes should be thoroughly rinsed in distilled or de-ionized water and the excess water shaken off or blotted dry with a lint-free wipe. Conductivity standards are much more sensitive to cross contamination/dilution than other standards; therefore, prior to immersion in a conductivity standard, all probes should be thoroughly rinsed and completely dried with lint-free wipes or compressed air. The conductivity probe on the sondes provides a linear reading of conductivity across the scale, so it is no longer necessary, as in some older technology meters, to calibrate with a standard close to what one may expect in the field. Therefore, due to the propensity of the standard to be easily diluted, one should use a relatively high concentration standard (typically in the 10,000 umho range) for conductivity calibrations.

Besides being easily diluted, conductivity also affects other parameters (specifically DO), therefore conductivity should always be the first parameter calibrated. The recommended order for calibration of the individual probes on a multiparameter sonde is as follows:

1. Conductivity
2. pH
3. DO
4. Turbidity/Chlorophyll/Rhodamine in any order

Rhodamine and Chlorophyll probes are calibrated in a similar fashion to turbidity. Specifically, the zero level is set using DI or distilled water followed by calibration to a known standard (typically 100 ppb for Rhodamine).

1.5 References

SESD Operating Procedure for Equipment Inventory and Management, SESDPROC-108, Most Recent Version

SESD Operating Procedure for Field Measurement of Dissolved Oxygen, SESDPROC- 106, Most Recent Version

SESD Operating Procedure for Field pH Measurement, SESDPROC-100, Most Recent Version

SESD Operating Procedure for Field Specific Conductance Measurement, SESDPROC- 101, Most Recent Version

SESD Operating Procedure for Field Turbidity Measurement, SESDPROC-103, Most Recent Version

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SEDS, Athens, GA, Most Recent Version

2.0 Methodology

2.1 General

With multiple probe options and customizable configuration, data sondes are extremely versatile tools for the measurement of in situ water quality. Effective use of multiparameter sondes takes additional planning and procedures beyond those described in the individual operating procedures for each parameter (i.e., DO measurement, pH measurement, etc.).

Data sondes may be operated and/or programmed via the manufacturer's display unit or a laptop computer. In either case, it is recommended that the user take the manufacturer's applicable User Manual in the field should difficulties be encountered. If the display unit does not have a power indicator, the batteries should be checked or the unit charged, as applicable, prior to use. Power to the sonde may be supplied by the display unit or by the internal batteries installed in the sonde (a setting on the display unit menu). If the sonde is being powered by the display unit, it is possible to calibrate and set up the sonde for unattended deployment, when in fact there are no batteries in the sonde (the battery voltage being read is for the display unit and not for the sonde). Therefore, it is very important to insure that there are actually batteries in the sonde. Calibration and setting up for an unattended deployment use very little battery power, therefore, it is recommended that sondes be powered from their own internal batteries and not from the display unit. New alkaline or freshly charged nickel metal hydride (NMIH) batteries should be installed in each sonde prior to each field study. Generally, if the sondes will be deployed on multiple occasions during a field study, new alkaline batteries should be installed when the sonde voltage falls below 11.5 volts at end check. Nickel metal hydride (NMIH) batteries operate at a lower voltage than alkaline (1.2 volts vs. 1.5 volts); therefore, if using rechargeable batteries, they should be recharged or replaced if voltage falls below 10.5 volts.

Specific units require that, for the parameters of interest, the appropriate sensor be enabled via the display or laptop prior to use. The field investigator should follow manufacturer's procedures to ensure all required probes are functioning. If a particular parameter is not needed, the sensor should be turned off, via the menu, in order to conserve battery power. It should be noted that turning the reporting of the parameter off does not turn off the probe, it simply turns off the display of the parameter (the parameter is still being logged). One must go into the "Sensor" menu to actually turn off the sensor.

2.2 Real-Time Monitoring

Real-time monitoring entails observing monitoring data via display unit or laptop computer as data is collected by the sonde. This data may be recorded in a field log book or logged to the internal memory of the sonde if so equipped. Logged data should be downloaded to a laptop or desktop computer as soon as possible. It is also recommended that download files be backed up in a separate location (USB thumb drives work very well for this). In addition,

even when logging data at regular intervals, it is recommended for real-time monitoring that data also be recorded in a field log book at some, likely less frequent, interval to ensure that some data is captured should the instrument logger fail.

Real-time monitoring generally involves hand-held deployment or attachment to a stationary object at the monitoring location. Hand-held deployments are useful for short-term monitoring in small, wadeable streams. For longer monitoring periods or to hold the sonde at a specific depth, attachment to a fixed object may be more effective. Fixed objects may include rocks or embedded logs already in place at the site or may include fence posts or rods placed by the field investigator prior to monitoring. Sondes may also be hung at desired depths from a boat on larger water bodies.

2.3 Profiling

Profiling involves real-time monitoring or individual measurements at several depths through a water column. Profiling is especially useful for documenting water column gradients or stratification of in situ parameters or for evaluating complete mix conditions in dye tracer studies. Profiling deployments are generally conducted by hand to provide the movement of the sonde through the water column; however, profiling can also be conducted using mechanical/ electrical winch or reel type devices. In profiling applications, the profiling cable should be labeled in some manner to indicate depth or the sonde calibrated for depth. In general, profiling data is recorded in a field log book along with the location and depth information for each measurement.

In fast moving waters it may be necessary to attach weight to the sonde. Weights should always be attached to the probe guard or sonde body, not the individual probes. If attached to the probe guard, weights should be secured in such a way that the weights and attachments do not interfere with probe operation. In all real-time and profiling applications, especially when the sonde is weighted, it is important to ensure that the profiling cable is securely attached to the baling harness of the sonde to prevent a disconnection of the sonde and potential loss or damage to the sonde.

It is important to note that SESD has two general type of sondes, vented and non-vented. Each type of sonde has its own profiling cable. The difference is how the depth sensor works. Non-vented sondes have a standard pressure or depth sensor that can be zeroed out at the site and will then accurately measure depth, typically to within a half a foot or less. Vented sondes have a small hole in the center of the connector pins where the cable attaches and are typically used to accurately (+/- 0.01 feet) measure changes in water stage level in unattended deployments, but may also be used for profiling applications. In order for a vented sonde to accurately measure depth or stage, the sonde **MUST** be used with a vented cable which vents to the atmosphere. If a vented sonde is used with a vented cable, just zero the depth at the site and measure depth as with a non-vented sonde. If a vented sonde is used with a non-vented cable it will **NOT** give accurate depth readings. Also, since vented sondes

are typically used for stage measurements, the depth sensor is only rated to a maximum depth of 30 feet, whereas non-vented sondes are typically rated to 200 feet.

2.4 Unattended Deployment

Unattended deployment entails pre-programming and deployment of a sonde at a specific location to log monitoring data in the absence of observation by a field investigator. Unattended deployments are useful for collecting data at regular intervals over extended monitoring periods, frequently up to 3 – 4 days. However, since no data are recorded by hand during the deployment, it is critical that the sonde be correctly programmed.

Programming of the sonde should follow the manufacturer's procedures for unattended deployment. The sonde may be programmed in the lab prior to a field study or programmed in the field. Programming of the sonde is typically accomplished either by the sonde's display unit or by laptop computer. Programming requires input of a start date/time, deployment duration, data log file name, and monitoring interval. Programming times should always be input in local time for the study area, unless otherwise noted in the field log. The field log book should also include the sonde identifier, the date/time of initial deployment, date/time of retrieval, deployment location, and sonde depth. Similarly, recorded times should be in local time for the study area.

In addition to enabling the required probes as described in Section 2.1, some units further require identification of the parameters to include in the logged data file. The field investigator should follow manufacturer's procedures to ensure all necessary data will be successfully logged.